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US Army Corps
of Engineers
BALTIMORE DISTRICT

FINAL REMEDIAL INVESTIGATION REPORT

REMEDIAL INVESTIGATION AT THE BUILDING 500 AREA
ADELPHI LABORATORY CENTER
ADELPHI, MARYLAND

Prepared by:
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U.S. Army Engineer District, Baltimore
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Baltimore, MD 21201

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ACRONYM LIST

AEHA	U.S. Army Environmental Hygiene Agency, now CHPPM
ALC	Adelphi Laboratory Center, formerly Harry Diamond Laboratories
AMSL	Above mean sea level
ARAR(s)	Applicable or relevant and appropriate requirement(s)
ATSDR	U.S. Public Health Service's Agency for Toxic Substances and Disease Registry
AWQC	Ambient water quality criteria
Ba	Barium
BaP	Benzo(a)pyrene
BCOE	Baltimore District, U.S. Army Corps of Engineers
BDA	Blowdown Area
BEHP	Bis(2-ethylhexyl)phthalate, also di(2-ethylhexyl)phthalate (DEHP)
Cd	Cadmium
CHPPM	U.S. Army Center for Health Promotion and Preventive Medicine, formerly AEHA
COC	Contaminant(s) of concern
$CPS_{o,d,i}$	Cancer potency slope factor (oral, dermal, inhalation)
1,1-DCE	1,1-Dichloroethene
cis-1,2-DCE	cis-1,2-Dichloroethene
trans-DCE	trans-Dichloroethene
DERA	Defense Environmental Restoration Account
2,6-DNT	2,6-Dinitrotoluene
4-Amino-2,6-DNT	4-Amino-2,6-dinitrotoluene
DWEL(s)	Drinking water equivalent level(s)
EPA	U.S. Environmental Protection Agency
FSP	Field Sampling Plan
gpm	Gallons per minute
GW	Groundwater
HMX	Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine
HQ	Hazard quotient
IARC	International Agency for Research on Cancer
IAS	Initial Assessment Study
IDM	Investigation derived media
IRP	Installation Restoration Program
$LADE_{o,d,i}$	Lifetime average daily exposure (oral, dermal, inhalation)
LTM	Long-term monitoring
MCL(s)	Maximum contaminant level(s)
MDE	Maryland Department of the Environment
MW	Monitoring well
NCE	Non-carcinogenic effects
Ni	Nickel
NIOSH	National Institute of Occupational Safety and Health
NSWC	Naval Surface Warfare Center
OWS	Oil/water separator
1,1,2,2-PCA	1,1,2,2-Tetrachloroethane
PCB(s)	Polychlorinated biphenyl(s)
PID	Photoionization detector
PPE	Personal protective equipment
PVC	Polyvinyl chloride

RBC(s)	Risk-based concentration(s)
RCRA	Resource Conservation and Recovery Act
RDX	Hexahydro-1,3,5-trinitro-1,3,5-triazine
RFA	Resource Conservation and Recovery Act Facility Assessment
RfD	RBC Table Reference Dose
RI	Remedial Investigation
SVOC(s)	Semivolatile organic compound(s)
SW	Surface water
TAL	Target Analyte List
TBC	To be considered (as in TBC criteria)
TCA	1,1,1-Trichloroethane
TCE	Trichloroethene
TCLP	Toxicity Characteristic Leaching Procedure
Tl	Thallium
TPH	Total petroleum hydrocarbons
TPH-DRO	Total petroleum hydrocarbons-diesel range organic
2,4,6-TNT	2,4,6-Trinitrotoluene
USCS	Unified Soil Classification System
UST(s)	Underground storage tank(s)
VOC(s)	Volatile organic compound(s)

EXECUTIVE SUMMARY

Under the direction of the DERA Installation Restoration Program, the Baltimore District, U.S. Army Corps of Engineers performed a Remedial Investigation at the Building 500 Area of the Adelphi Laboratory Center, Adelphi, MD.

The investigation was conducted in two phases. Phase I, during May-July 1996, included the installation of seven groundwater monitoring and two observation wells; sampling of seven newly installed wells, four existing monitoring wells and three off-site residential wells; collection and analysis of soil samples from three soil borings; and collection and analysis of three surface water and three sediment samples. Phase II, during April-June and August 1997, involved the installation of two bedrock monitoring wells, sampling of 13 monitoring wells and two off-site residential wells; sampling of three surface water and sediment locations; and sampling of the oil/water separator at Building 500. The overall objective of the Remedial Investigation was to determine the nature, extent and source(s) of contamination present, characterize the hydrogeology in the Building 500 Area, and provide a human health risk assessment.

Among the significant findings of this investigation was the detection of chlorinated organic solvents—trichloroethene (TCE) and 1,1,2,2-tetrachloroethane (1,1,2,2-PCA)—contamination in up to seven groundwater monitoring wells above the Safe Drinking Water Act regulatory maximum contaminant level (MCL) or EPA Risk-Based Concentration. TCE concentrations that exceed the MD Ambient Water Quality Criteria were detected at two surface water sample locations, one of which was off-site. TCE was not detected in any off-site residential wells. Additionally, explosive compounds were detected in three groundwater monitoring wells and two surface water samples.

Total cadmium (Cd) detected in unfiltered groundwater exceeded the MCL at two groundwater monitoring wells in Phase I. Detections above the MCL at these two wells were not confirmed during Phase II. However, a third well had total and dissolved Cd above the MCL. In general, concentrations of dissolved metals are more representative of the water quality in the aquifer than total metals results, because total metals concentrations include metals that were associated with suspended solids in the water sample. Therefore, given a dissolved Cd result exceeding the MCL in only one well, there does not appear to be a significant source of Cd contamination in the Building 500 Area.

Although thallium (Tl) was considered a contaminant of concern based on an AEHA (1994) study, it was not detected above a reporting limit of 0.5 µg/l. The MCL for Tl is 2 µg/l. Therefore, Tl does not appear to be a concern at the Building 500 Area.

Benzo(a)pyrene was detected during one out of three sampling events at concentrations exceeding soil screening levels at sediment sampling locations in the streams on either side of the [redacted] residence.

No pesticides or polychlorinated biphenyls (PCBs) were detected in the groundwater at the Building 500 Area.

Diesel range petroleum hydrocarbons were detected in the well in Building 500, in the sample from the oil/water separator, and in two sediment locations.

Cyanide was not found above detection limits of 0.01 mg/l for water samples and 1 mg/kg for sediment samples.

The spatial distribution of TCE and explosive compounds in groundwater indicates that the source of the contamination is located upgradient of the Building 500 Area. TCE contaminated groundwater appears to be intercepted by the subdrainage system in Building 500 and discharged through the oil/water separator into a small, unnamed stream that flows into Paint Branch Creek. In addition, TCE contaminated groundwater discharges into the Site W swale and from there into Paint Branch Creek. The Naval Surface Warfare Center (NSWC) is located upgradient of the Building 500 Area. A Remedial Investigation conducted in 1992 at the NSWC concluded that TCE was present in the groundwater at NSWC Site 9. Additionally, the NSWC has a documented history of contamination with nitroaromatic compounds that include HMX, RDX, 2,6-DNT, and nitrobenzene.

Based on the comparison of highest detected concentrations of contaminants in groundwater (GW), surface water (SW), sediment, and soil to ARARs and TBC criteria, the contaminants posing potential elevated carcinogenic risks and non-carcinogenic hazards to humans are as follows: TCE, 1,1,2,2-PCA RDX, and Cd in GW; TCE and 1,1,2,2-PCA in SW; and benzo(a)pyrene in sediment.

Carcinogenic risks posed by TCE and 1,1,2,2-PCA in GW and SW from ingestion, inhalation and dermal exposure were in the 10^{-5} to 10^{-7} range. The overall additive carcinogenic risks to the above contaminants through individual and multiple exposure pathways were in the 10^{-5} range. Cd is not recognized as presenting a carcinogenic ingestion risk. Although there were elevated levels of Cd in GW, the inhalation exposure pathway for Cd was determined to be insignificant. Exposure to BaP in sediment, through ingestion and dermal pathways, posed a carcinogenic risk in the 10^{-5} to 10^{-6} range.

For the most sensitive population (child), the additive non-carcinogenic hazard posed by TCE, RDX , and Cd at the site exceeded the threshold hazard quotient. Use of highest detected concentrations in the hazard assessment yielded a hazard quotient of 4.38. Calculations involving mean values for TCE and Cd resulted in an overall hazard quotient of 2.17.

The risk assessment intentionally overestimates carcinogenic and non-carcinogenic effects through use of highest detected concentrations of contaminants in the calculations. This conservative scenario assumes that the contaminant plume(s) will migrate off-site retaining the maximum concentrations observed in the Building 500 Area. Hydrogeologic investigations indicate that it is extremely unlikely that contaminants will migrate into bedrock, where off-site residential wells are located. Therefore, the groundwater pathway for TCE, 1,1,2,2-PCA, RDX, and Cd is believed, on hydrogeologic grounds, to be insignificant. Similarly, results from surface water sampling indicate that the highest observed concentrations will not reach downgradient locations in the streams on either side of the [redacted] residence. VOC concentrations are greatly reduced through volatilization and dilution before reaching [redacted] property. The risk associated with surface water is consequently greatly reduced from the risk as calculated in the risk assessment.

Based on the findings of the Building 500 Area Remedial Investigation, the following actions are recommended:

- Initiate an Annual Long-Term Monitoring Program. The program would include sampling of 10 existing monitoring wells, two off-site residential wells, and three surface water/sediment locations. Sampling would target known contaminants and strategically located wells. Sampling of the residential wells would be discontinued when the residences are connected to public water supply.

- Share Building 500 Area Remedial Investigation findings with the Naval Surface Warfare Center. Coordinate future investigations in the Building 500 Area with the NSWC, because the source of contamination at Building 500 appears to be located on NSWC property.

1.0 INTRODUCTION

1.1 Purpose

Under the direction of the DERA Installation Restoration Program (IRP), the Baltimore District, U.S. Army Corps of Engineers (BCOE) performed a Remedial Investigation (RI) to characterize the nature, extent, and source(s) of contamination in the Building 500 Area at the Adelphi Laboratory Center (ALC) in Adelphi, MD.

The investigation included the installation of groundwater monitoring and observation wells; sampling of monitoring wells and off-site residential wells; collection and analysis of soil samples from soil borings; collection and analysis of surface water samples and the collection and analysis of sediment samples. The investigation was conducted in two phases: Phase I was carried out in May, June, and July, 1996, and Phase II was carried out in April, May, June, and August, 1997. Data obtained from both phases were analyzed to determine nature, extent and source(s) of contamination and potential future actions. Phase II activities were guided, in part, by results from Phase I.

1.2 Objective

The overall objective of this investigation was to determine the nature, extent and source(s) of contamination present in groundwater and to characterize the hydrogeology in the Building 500 Area. Information generated during this investigation was reviewed to determine if any additional action(s) were warranted at the site.

The work performed during this investigation consisted of eight principal tasks. Task-specific objectives and rationale for proposed field work are provided below.

1.2.1 Monitoring Well Drilling and Installation

Data were obtained from drilling, installing, and geotechnical testing of soil samples to characterize the subsurface geology of the Building 500 Area. Seven wells were installed during Phase I and two during Phase II.

1.2.2 Hydraulic Conductivity Testing

Data were obtained from slug tests and in situ permeability tests to characterize the hydrogeology of the Building 500 Area.

1.2.3 Soil Borings

As part of Phase I, soil borings were advanced adjacent to three existing underground storage tanks (USTs) to determine if the USTs are sources of contamination in the Building 500 Area.

1.2.4 Groundwater Sampling

During Phase I, data were obtained from sampling four existing and seven newly installed monitoring wells to characterize the nature, extent and source(s) of groundwater contamination in the Building 500 Area. Sampling during Phase II was conducted in two rounds and included the 11 pre-existing wells, plus two additional bedrock wells.

1.2.5 Sampling of Blowdown Area (Area of Concern C)

A soil sample was collected during Phase I to determine the nature and extent of contamination present at the blowdown area, which was identified as an area of concern in the RCRA Facility Assessment (A.T. Kearney, Inc., 1990).

1.2.6 Surface Water Sampling of Bldg 500 Drains, Site W Drainage Swale, and [redacted] Streams

Surface water samples were collected at the Site W drainage swale to determine if Site W is a source of contamination and to fill the data gaps from previous investigations. Samples were not collected from the floor drains as initially planned because the sampling data were obtained by Target Environmental Services, Inc. (Target, 1996). A sample was collected from the oil/water separator (OWS) to evaluate its potential as a source of (or conduit for) contamination. The OWS discharges into a culvert at the head of an unnamed stream that flows into Paint Branch Creek. Surface water samples were collected from unnamed streams on either side of the [redacted] residence to determine whether any contaminants present in the Site W swale and the OWS were migrating off-site.

1.2.7 Sediment Sampling of Site W Drainage Swale and [redacted] Streams

The drainage swale sampling was performed to determine if Site W is a source of contamination and to fill the data gaps from previous investigations. Sediment samples were also collected from the unnamed streams on either side of the [redacted] residence to determine the presence of contaminants.

1.2.8 Off-site Residential Well Sampling

Water sampling was performed to determine water quality at the off-site residential wells. Existing groundwater elevation data indicate that off-site residential wells ([redacted] and [redacted] are [redacted] of the Building 500 Area. Previous sampling of the [redacted] well did not detect contamination. However, in 1994 groundwater contamination was detected on ALC property by U.S. Army Environmental Hygiene Agency (AEHA). A records search was performed to determine residential well construction information. Well construction data were used in evaluating the groundwater quality information obtained from the analysis of the residential well samples. Sampling of the [redacted] well was discontinued after Phase I.

1.3 Site Background

1.3.1 Site Description

ALC is located in Maryland approximately 5 miles northeast of Washington D.C. (Figure 1-1). The ALC installation covers approximately 159 acres of Prince George's and Montgomery Counties. Approximately 83 acres of ALC are located in Montgomery County and 76 acres are located in Prince George's County. The focus of this RI is the Building 500 Area on the northeastern portion of the ALC facility.

1.3.2 Site History and Contaminants

ALC develops electronic fuses for projectiles, missiles and associated technology. ALC has performed research on fluidics and nuclear weapons effects technologies. Operations which support this mission have included metals plating, an impulse generator, photographic operations, and production of printed circuit boards. All operations are on a small test scale and wastes are generally generated in small quantities. Additionally, the installation has multiple support activities.

1.3.3 Previous Investigations

1.3.3.1 Naval Surface Warfare Center

In November of 1984, an Initial Assessment Study (IAS) Report at the adjacent Naval Surface Warfare Center (NSWC) concluded that seven of the 14 sites investigated at NSWC posed a potential threat to human health and the environment sufficient to warrant further study. The IAS was followed by a Verification Study, a Confirmation Study and a Phase I and II Remedial Investigation (Malcolm Pirnie, 1992).

The NSWC RI addressed the seven sites identified in the IAS Report. Site 9–Industrial Wastewater Disposal Area 300 is located uphill north-northwest of Building 500 and is a potential source of groundwater contamination for the Building 500 Area. Liquid wastes containing explosive compounds and solvents were discharged to the ground surface and to leaching wells. The RI-NSWC concluded that groundwater in the vicinity of Site 9 contained nitroaromatic compounds (HMX, RDX, 2,6-DNT, and nitrobenzene), trichloroethene (TCE) and low levels of dissolved metals. Groundwater flow direction was determined to be towards the south-southeast, towards the confluence of an intermittent stream and a perennial stream.

1.3.3.2 Building 500

AEHA performed an investigation of the potential groundwater and surface water contamination from Building 500 and the NSWC (Geohydrologic Study No. 38-26-K106-94, 1994).

AEHA was requested by ALC to investigate groundwater and surface water contamination from two sources: the Building 500 area and NSWC. Potential sources of contamination in the Building 500 area include the NSWC Site 9 discussed above, two former 890,000 gallon aboveground storage tanks (removed in 1996) that contained non-polychlorinated biphenyl (PCB) transformer oil located on the east side of Building 500, three underground storage tanks located on the south sides of Buildings 504 and 505, an oil/water separator located on the south side of Building 500, and past spills of non-PCB transformer oil in Building 500.

The AEHA investigation included installing and sampling four groundwater monitoring wells in the vicinity of Building 500. Additionally, surface water and sediment samples were collected from six locations. Two rounds of field samples were collected in May and September 1994. AEHA concluded:

- Groundwater flow was to the southwest in the Building 500 area;

- Thallium, nickel, dichloromethane and trichloroethene (TCE) exceeded drinking water standards in at least one groundwater sample collected in either May or September 1994. Petroleum hydrocarbons were detected at low levels in all groundwater samples collected in May 1994 and in one sample collected in September 1994.

- An upgradient source of thallium, dichloromethane and petroleum hydrocarbons was suspected. The source of TCE and nickel is unknown.

- Explosive compounds (2,4,6-TNT and RDX) were detected in a surface water sample collected from a drainage swale on the east side of Building 500. Petroleum hydrocarbons were detected in a sediment sample collected from the same location. AEHA concluded that location is a probable discharge point for groundwater and that, based on topography, the location receives groundwater and surface water discharge from NSWC property.

1.3.3.3 Site W

In 1995 ALC acquired property east of Building 500 from NSWC that is referred to as Site W. A waste storage building was located on this site. As part of the property transfer process an initial investigation was performed by BCOE. Subsequently, a Preliminary Assessment of the area was performed (Plexus Engineering Group, 1995). Analysis of soil samples collected by the BCOE indicated the presence of heavy oil and trace amounts of barium and chromium. Analysis of soil samples collected during the PA indicated the presence of TCLP metals (barium, chromium and lead) and PCBs below regulatory levels. DDE and DDT were detected at low levels from an upgradient sample location. Explosives and TPH were not detected in any samples.

1.3.3.4 Blowdown Area (Area of Concern C)

A Resource Conservation and Recovery Act Facility Assessment (RFA) was performed for ALC (formerly Harry Diamond Laboratories) in 1989-1990 (A.T. Kearney, Inc., 1990). AEHA performed an evaluation of the solid waste management units at the facility (Groundwater Quality Survey No. 38-26-KF66-92, 1992).

During the visual site inspection phase of the RFA, a soil stain, approximately 3 feet by 5 feet in size, was observed on the northeast side of Building 500. The stain apparently was caused by the discharge of pump oil from a vacuum system bleed-off. The RFA suggested soil samples be collected and analyzed to determine the nature and extent of contamination.

1.3.3.5 [redacted]

A residential well owned by Mr. [redacted] of [redacted] is located approximately [redacted] [redacted] of Building 500. In May 1994, NSWC personnel sampled this well when Mr. [redacted] complained of a bad odor in his drinking water. No total petroleum hydrocarbons were found at a detection limit of 1 mg/l. The well was sampled concurrently in September 1994 by AEHA and NSWC (AEHA, 1994) for metals, volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), and total petroleum hydrocarbons (TPH). No contaminants were detected at or above detection limits in any of the samples taken.

1.3.3.6 Target Environmental Services Report

In May 1996, Target Environmental Services, Inc. conducted soil, groundwater and effluent water sampling at ALC Building 500 (Aurora). A total of 14 soil samples were collected from 0.5 to 6 feet below ground surface. A total of 8 water samples were collected. All soil samples were analyzed by gas chromatography with mass spectrometric detection. A customized selected ion monitoring mass spectrometric method was developed for the analysis of the Aurora dielectric fluid to enable the differentiation between the Aurora dielectric fluid and common diesel range organic contaminants.

Elevated concentrations of the Aurora dielectric fluid were found to be present in some shallow soil samples. The contamination was found to be of limited extent. No significant levels of contamination were detected in the three groundwater samples encountered by the probes. Effluent water samples were found to contain elevated levels of Aurora dielectric fluid. Results from the water analysis indicate that there is product in the effluent pipe systems. Product appears to be in the exit pipe from Building 500 that originates from the drain and in the drainage pipe from the vault leading to the oil/water separator.

2.0 FIELD INVESTIGATION PROGRAM

BCOE performed the fieldwork for this RI in two phases: Phase I in May, June and July, 1996 and Phase II in April, May, June, and August, 1997. Major organizational elements of BCOE that participated in this RI included Project Planning Management Division; Hazardous, Toxic and Radioactive Waste Branch; and Geotechnical & Water Resources Branch. The principal tasks common to both Phase I and II involved monitoring well installation, hydraulic conductivity testing, groundwater sampling, surface water sampling, sediment sampling, residential well sampling, and investigation derived media management. Drilling of soil borings in the vicinity of three USTs and the oil/water separator and soil sampling from the blowdown area were limited to Phase I. Groundwater, surface water, and sediment sampling was conducted in two rounds during Phase II. Round 1 was performed in May, and Round 2 was in August.

2.1 Monitoring Well Drilling and Installation

All well locations were cleared by the base utility clearance personnel prior to conducting any subsurface field activities. The field procedures for monitoring well drilling and installation were completed in accordance with Section 4.1 of the Field Sampling Plan (FSP, BCOE, 1996) and Section 4.0 of the FSP (BCOE, 1997).

2.1.1 Phase I—Summer 1996

Seven 2-inch diameter monitoring wells (C-5 through C-8 and C-11 through C-13) and two 1-inch diameter observation wells (C-9 and C-10) were installed during this investigation (Figure 2-1). The 2-inch monitoring wells (C-5 through C-8 and C-11 through C-13) were installed for the purpose of collecting static water level readings and water quality samples to delineate the extent of groundwater contamination in the Building 500 Area. The two 1-inch diameter observation wells (C-9 and C-10) were installed to gather static water level readings.

The well screens in monitoring wells C-5 through C-8 and C-12 straddled the watertable in the unconsolidated overburden and residual soils overlying bedrock. The well screen in monitoring well C-13 straddles the watertable in shallow bedrock underneath Building 500. The well screen in monitoring well C-11 is installed completely in the bedrock adjacent to well A-4.

All boreholes for monitoring wells were advanced using hollow stem auger and rotary drilling methods. The borehole for C-11 was advanced into bedrock using an HQ coring bit. Soil samples were collected on two and a half foot centers for the first twenty feet and then on five foot centers to the bottom of the hole or top of rock. Soil samples were examined visually and were described for geotechnical parameters in the field according to the Unified Soil Classification System (USCS). All soil samples were screened with a photoionization detector (PID) to determine if volatile organic compounds were present. A total of eight soil samples were chosen from six boreholes (C-5, C-6, C-7, C-8, C-9, and C-10) for geotechnical testing that consisted of mechanical analysis with hydrometer and percent organic matter. Testing was performed by the BCOE Soils Laboratory at Ft. McHenry Yard, Baltimore, MD. Rock core obtained in C-11 and C-12 was visually classified in the field. Boring logs are contained in Appendix A.

Monitoring wells C-5 through C-8, C-11 and C-12 were constructed with Schedule 40 polyvinyl chloride (PVC) casing and a 20 foot section of 0.010 inch slot PVC well screen. Well C-13 was constructed with an approximately 1 foot riser PVC casing and a 10 foot, 0.010 inch slot, Schedule 40 PVC screen section. Both one-inch diameter observation wells, C-9 and C-10, were constructed of Schedule 40 PVC casing and a 20 foot section of 0.010 inch slot PVC well screen. All monitoring and observation wells installed during this investigation were installed using Morie 00 sand as a filter pack. Well construction forms are provided in Appendix B.

Monitoring wells C-5 through C-8, C-11, C-12 and observation wells C-9 and C-10 were completed with a well casing stickup of approximately 2 feet. Each well is protected by a 6 x 6 inch protective casing. Well C-13 was installed inside Building 500 and completed as a flush mount well. See Table 2-1 for the well construction summary. The newly installed monitoring wells and observation wells and the four existing monitoring wells were surveyed for horizontal and vertical location by Thomas, Moore & Associates, Inc. of Frederick, MD (Table 2-1 and Appendix A).

Monitoring wells C-5 through C-8, and C-12 were developed by surging the well and then pumping with a hand pump and actuator. C-11 and C-13 were developed using a disposable bailer due to the extremely slow recharge rate of these wells. C-11 had its screen placed in highly competent rock with virtually no fractures, and C-13 was placed in high blow count, disintegrated rock. Monitoring wells were to be developed until the water pumped out appeared clear to the unaided eye. All monitoring wells were developed. However, some wells did not produce water that was as clear in appearance as others due to the low yield of many of the wells. The low yield did not allow for removal of fines from the well. Measurements of temperature, pH, turbidity, and conductivity were taken throughout development. All purge water was discharged to the surface 50 feet or more from any well. Observation wells C-9 and C-10 were designed to measure water levels only; therefore, these wells were not developed. Well development forms are provided in Appendix B.

2.1.2 Phase II—Spring and Summer 1997

Two monitoring wells, C-14 and C-15, were installed as open-hole bedrock wells adjacent to overburden monitoring wells C-6 and C-7, respectively (Figure 2-1). The bedrock wells were installed for the purpose of collecting static water level readings and water quality samples to determine whether contaminants in the overburden portion of the surficial aquifer were migrating into the bedrock portion of the aquifer.

All boreholes for monitoring wells were advanced using hollow stem auger and rotary drilling methods in overburden, followed by an HQ coring bit in bedrock. Starting at the approximate depths at which C-6 and C-7 were terminated, soil samples were collected on five foot centers to the top of rock. Continuous rock core was collected to the bottom of the holes. Soil samples were examined visually and were described for geotechnical parameters in the field according to the USCS. All soil samples were screened with a PID to determine if volatile organic compounds were present. Four samples from each borehole were collected for laboratory testing that consisted of visual classification. Rock core obtained in C-14 and C-15 was visually classified in the field. See Appendix A for boring logs.

The bedrock wells consist of 4-inch diameter Schedule 40 PVC casing grouted into bedrock, with an unscreened (open-hole) 3.78-inch diameter interval of bedrock below. The wells were completed with a well casing stickup of approximately 2 feet. Each well is protected by a 6 x 6 inch protective casing. See Table 2-1 for the well construction summary and Appendix B for well construction details. The wells were surveyed for horizontal and vertical location in the field (Table 2-1 and Appendix A).

The wells were developed by swabbing and surging the well and then pumping with an Aardvark Aqua-Developer. C-14 and C-15 were both in highly competent rock with virtually no fractures, and recharge was very slow. Pumping rates of approximately 1.5 gpm for C-14 and 1 gpm for C-15 resulted in repeated drawdown in the wells until they were dry. Measurements of temperature, pH, turbidity, and conductivity were taken throughout development. Development criteria—including volume of water removed, stabilization of water quality parameters, and clarity—were met for both wells. All purge water was containerized. Well development forms are provided in Appendix B.

2.2 Hydraulic Conductivity Testing

2.2.1 In Situ Permeability Testing

The borehole at observation well C-9 was selected for in situ permeability testing to provide a vertical profile of permeability values at the site (Figure 2-1). Three constant head packer tests were completed in the borehole prior to installation of the well. The testing was completed by placing the packer into the test section of the borehole and inflating the packer with nitrogen. Water was added to the test section below the packer. The water level was maintained at a predetermined level for 10 minutes. Using the volume of water added and the time interval of the test, hydraulic conductivity values were calculated for the three tests. Field procedures for in situ permeability testing are detailed in Appendix F of the FSP (BCOE, 1996).

2.2.2 Slug Testing—Phase I

Hydraulic conductivity (slug) tests were performed on six monitoring wells, A-4, C-6, C-7, C-8, C-11 and C-12, to estimate values of hydraulic conductivity in the Building 500 Area (Figure 2-1). The slug testing method involves the instantaneous addition or subtraction of a volume of water (slug) to a well or piezometer and monitoring the water levels as the aquifer responds to the slug-induced head changes. A mechanical slug made from solid PVC is used to displace water and change the head in the well or piezometer. A slug test typically consists of two parts, a falling head test and a rising head test. The falling head test occurs after the slug is inserted into a well. The rising head test occurs after the slug is removed from the well. Water levels were recorded using a downhole pressure transducer connected to an automated logger. Detailed field procedures for slug testing are discussed in Appendix D of the FSP (BCOE, 1996).

2.2.3 Slug Testing—Phase II

Slug tests were performed on monitoring wells C-14 and C-15. Due to extremely slow response, data were collected only from falling head tests.

2.3 Soil Borings

Three soil borings were drilled in the vicinity of potential sources of soil and groundwater contamination in the Building 500 Area (Figure 2-2). All borings were advanced using a hollow stem auger, sampling continuously to the groundwater table. Borings were drilled in the vicinity of the 1,000 gallon UST near Building 504 (TB-2), the 3,000 gallon UST near Building 504 (TB-3) and the 550 gallon UST near Building 505 (TB-4). Soil samples were visually logged for geotechnical properties and screened using a PID with an 11.7 eV bulb to determine if volatile organic compounds were present and to assist in determining where to collect samples from. At soil boring TB-2, no PID readings above background were observed before terminating the borehole at 10 feet below ground surface, with water first encountered at 6.57 feet. A soil sample was taken from the 4-6 foot interval. At soil borings TB-3 and TB-4, PID readings above background were observed at 1.6 and 5.7 feet below ground surface, respectively. A single soil sample was taken from each interval encompassing the areas at TB-3 and TB-

4 where VOCs were suspected based on PID readings. In addition, a duplicate sample was collected at TB-4. The samples were analyzed for VOCs (EPA 8260) and SVOCs (EPA 3540/8270). Soil boring logs are provided in Appendix A. The field procedures for this task are detailed in Section 4.2 of the FSP (BCOE, 1996).

2.4 Groundwater Sampling

2.4.1 Phase I

Groundwater samples for laboratory chemical analysis were collected from the seven newly installed 2-inch diameter groundwater monitoring wells (C-5, C-6, C-7, C-8, C-11, C-12, and C-13), four existing monitoring wells installed by AEHA (A-1, A-2, A-3, A-4) and three domestic water wells at the [redacted] and [redacted] residences (Figure 2-1). Groundwater samples were not collected from the two newly installed one-inch water observation wells (C-9 and C-10). Groundwater samples were analyzed for VOCs (EPA Method 8260), Target Analyte List (TAL) Metals (filtered and unfiltered, EPA SW-846), SVOCs (EPA 3540/8270), pesticides and PCBs (EPA 3540/8081) and explosive compounds (EPA 8330).

Prior to sampling, the wells were opened and screened with a PID. General site conditions and field observations were noted in the field log book. Water levels were gauged in the wells and the volume of water to be purged prior to sampling was calculated. Wells were purged of five times the volume of water in the well casing and filter pack. The purge water was discharged to ground surface no closer than 50 feet from the nearest well. The samples were then collected using a disposable top loading bailer. The samples were placed in the appropriate laboratory prepared sample containers. Sample containers were placed in a cooler with a temperature of 4°C and sent to the laboratory for chemical analysis. All samples were accompanied by a chain of custody from the field to the laboratory. The field procedures for this task are detailed in Section 4.3 of the FSP (BCOE, 1996).

2.4.2 Phase II

Groundwater samples for laboratory chemical analysis were collected from the eleven existing (A-1, A-2, A-3, A-4, C-5, C-6, C-7, C-8, C-11, C-12, and C-13) monitoring wells, two newly installed bedrock wells (C-14 and C-15) and domestic water wells at the [redacted] and [redacted] residences (Figure 2-1). Groundwater samples were not collected from the [redacted] residential well.

Significant changes were made in the sampling program between Phase I and Phase II and between Rounds 1 and 2 of Phase II to reflect accumulated knowledge of actual or potential contaminants. No changes were made in VOC (EPA 8260) and explosive compounds (EPA 8330) analysis. The details of the sampling program are provided in Table 2-2. In general the following changes were made:

1) Based on previous results, pesticides and PCBs were not included in Phase II.

2) To meet lower detection limit requirements, TAL Metals analysis was augmented by analyzing for antimony (EPA 3005/7440), beryllium (EPA 3005/7090), cadmium (EPA 3005/7130), and thallium (EPA 3005/6020) during Round 1 of Phase II.

3) Based on the results of Round 1, metals analysis was extensively curtailed during Round 2. Analysis was limited to select parameters at specific wells. Analysis focused on the residences, sampling locations with known contamination, and locations downgradient of areas with known contamination. See Table 2-2 for details.

4) Cyanide (ILM04.0) and TPH-DRO (EPA 3540/8015M) were added to the list of analytes during Round 1 of Phase II.

5) Based on the results of Round 1, cyanide was not included during Round 2. TPH-DRO analysis was extensively curtailed during Round 2. Analysis was limited to select parameters at specific wells. Analysis focused on the residences, sampling locations with known contamination, and locations downgradient of areas with known contamination. See Table 2-2 for details.

6) Based on previous results, BEHP (EPA 3540/8270) was the only SVOC included during Round 2 for monitoring well and surface water samples. The full suite of SVOCs (EPA 3540/8270)was retained for sediment and residential well samples.

General site conditions and field observations were noted in the field log book. Prior to sampling, the wells were opened and screened with a PID. Water levels were gauged in the wells. Sampling techniques varied depending on recharge rate and height of water in the wells. Low flow purging and sampling was the desired method, but could only be applied to wells with adequate recharge rates (A-3, A-4, C-5, C-6, C-7, C-8 and C-12). Wells C-13 and A-1, with extremely low recharges rates and an inadequate column of water for the pump, were bailed dry and allowed to recharge before collecting samples with a disposable bailer. Well A-2 was pumped dry, then allowed to recharge and sampled with a pump. The bedrock wells—C-11, C-14, and C-15—had insufficient recharge rates to allow low flow purging and sampling. The bedrock wells were sampled by pumping at the lowest rate possible, but one that still produced continuous drawdown. Groundwater quality parameter stabilization was achieved for the bedrock wells, which suggests that some formation water was entering the wells. The samples were placed in the appropriate laboratory prepared sample containers. Sample containers were placed in a cooler with a temperature of4°C and sent to the laboratory for chemical analysis. All samples were accompanied by a chain of custody from the field to the laboratory. The field procedures for this task are detailed in Section 4.2 of the FSP (BCOE, 1997).

Purge water for the majority of wells was discharged to ground surface no closer than 50 feet from the nearest well. Purge water from wells that were known to be contaminated (A-1, C-5, C-6, C-7, C-8, and C-13) was containerized in 55 gallon drums, as specified in Section 7.0 of the FSP (BCOE, 1997). Because C-14 and C-15 were installed adjacent to contaminated wells, purge water was containerized.

2.5 Blowdown Area (Area of Concern C)

A soil sample was collected from the blowdown area (Area of Concern C as designated in the RFA) to determine if contamination is present. The area is located on the northeast side of Building 500 beneath the vacuum system bleed-off pipe (Figure 2-2). The soil sample was collected with a hand auger from 14-20 inches below the ground surface, in accordance with section 4.4.1 of the FSP (BCOE, 1996). The sample was placed in the appropriate laboratory prepared sample container and placed in a cooler with a temperature of 4°C. The sample was sent to the laboratory and analyzed for VOCs (EPA 8260) and SVOCs (EPA 3540/8270). The field procedures for this task are detailed in Section 4.4 of the FSP (BCOE, 1996).

2.6 Surface Water Sampling of Bldg 500 Drains/Site W Drainage Swale

2.6.1 Phase I

Surface water samples for laboratory chemical analysis were collected from the drainage swale behind Building 500 (sample SW-3) and from the streams on either side of the [redacted] residence (samples SW-1 and SW-2), as shown in Figure 2-1. Surface water sampling of Building 500 floor drains (Figure 2-2) was completed by others (Target, 1996). The surface water samples were obtained using a stainless steel dipper in order to prevent unnecessary contamination of the outer surface of the sample bottle that would otherwise result from direct immersion in the source. The samples were placed in the appropriate laboratory prepared sample containers. Sample containers were placed in a cooler with a temperature of 4°C and sent to the laboratory for chemical analysis for VOCs (EPA 8260), SVOCs (EPA 3540/8270), TAL Metals, pesticides and PCBs (EPA 3540/8081), and explosive compounds (EPA 8330). The samples were accompanied with a chain of custody from the field to the laboratory. The field procedures *for this task are detailed in Section 4.5 of the FSP (BCOE, 1996).*

2.6.2 Phase II

Surface water samples SW-1, SW-2, and SW-3 were collected as outlined in Section 2.6.1 above. Sample OWS was collected from the effluent tank of the oil/water separator during Round 1 only. Round 2 sampling of the oil/water separator was not accomplished due to installation of an air stripper for effluent from Building 500. Analytical methods were the same as for Phase II groundwater samples, as described in Section 2.4.2. Changes in the suite of analytes to reflect actual or potential contaminants are outlined in Section 2.4.2 above and shown in Table 2-2. The field procedures for this task are detailed in Section 4.3 of the FSP (BCOE, 1997).

2.7 Sediment Sampling of Site W Drainage Swale and [redacted] Streams

2.7.1 Phase I

Sediment samples for laboratory chemical analysis were collected from the drainage swale behind Building 500 (sample SW-3) and from the streams on either side of the [redacted] residence (samples SW-1 and SW-2), as shown in Figure 2-1. Note that samples SW-1, SW-2, and SW-3 are referred to as SD-1, SD-2, and SD-3 in subsequent sampling events to avoid confusion with the surface water samples. Samples were obtained using a stainless steel scoop to remove the top 2-3 inches of sediment. The samples were placed in the appropriate laboratory prepared sample containers. The sample containers were placed in a cooler with a temperature of 4°C and sent to the laboratory for chemical analysis for VOCs (EPA 8260), SVOCs (EPA 3540/8270), TAL Metals, pesticides and PCBs (EPA 3540/8081), and explosive compounds (EPA 8330). The samples were accompanied by a chain of custody from the field to the laboratory. The field procedures for this task are detailed in Section 4.6 of the FSP (BCOE, 1996).

2.7.2 Phase II

Using the same sampling techniques, sediment samples were taken from the same drainage swale and streams as in Phase I (Figure 2-1). These samples are referred to as SD-1, SD-2, and SD-3. During Round 1 of Phase II, sample analysis was identical, except that pesticides and PCBs were eliminated and TPH-DRO (EPA 3540/8015M) was added (Table 2-2). For Round 2, changes in the suite of analytes to reflect actual or potential contaminants are outlined in Section 2.4.2 above and shown in Table 2-2. The sampling procedures are described in Section 4.3 of the FSP (BCOE, 1997).

2.8 Off-site Residential Well Sampling

2.8.1 Phase I

Residential well samples for laboratory chemical analysis were collected at the [redacted] [redacted] and [redacted] residences (Figure 2-1). The [redacted] residence was added to the work plan upon request of the homeowner to field personnel and upon approval of Bob Craig, the ALC representative. Samples were taken from a utility sink in the basement of the [redacted] residence and from an outside faucet at the [redacted] and [redacted] residences. These samples were analyzed for VOCs (EPA 8260), SVOCs (EPA 3540/8270), TAL Metals (filtered and unfiltered), pesticides and PCBs (EPA 3540/8081), and explosive compounds (EPA 8330).

Prior to sampling, each faucet was purged for five minutes. The samples were then collected in the appropriate laboratory prepared sample containers. Sample containers were placed in a cooler with a temperature of 4°C and sent to the laboratory for chemical analysis. All samples were accompanied by a chain of custody from the field to the laboratory. The field procedures for this task are detailed in Section 4.7 of the FSP (BCOE, 1996).

2.8.2 Phase II

The [redacted] and [redacted] residential wells were sampled during Phase II; the [redacted] well was not. In addition, an attempt was made to sample an unused well at the [redacted] residence at the request of Bob Craig, the ALC representative. Due to iron precipitation in the well, it was not possible to obtain a sample. As during Phase I, the [redacted] well sample was obtained from the utility sink in the basement. The [redacted] well sample was taken from a tap located at the water tank "upstream" of water filtration apparatus. Analytical methods were the same as for Phase II groundwater samples, as described in Section 2.4.2. However, based on previous results analyses for cyanide (ILM04.0), antimony (EPA 3005/7440), and beryllium (EPA 3005/7090) were not performed (Table 2-2). The field procedures for this task are detailed in Section 4.4 of the FSP (BCOE, 1997).

2.9 Investigation Derived Media (IDM) Management

2.9.1 Phase I

All drill cuttings, development and well purge water generated during the field investigation were disposed of according to EPA publication 9345.3-03FS, "Guide to Management of Investigation-Derived Wastes". The EPA IDM management approach was followed to minimize the generation and handling of IDM and was agreed upon during the 19 March 1996 ALC Team meeting with the Maryland Department of the Environment (MDE).

IDM that did not appear contaminated (based on odor, visual observation and PID readings) was not containerized. Soil cuttings that did not appear contaminated were spread out on the ground surface adjacent to the borehole. Purge and development water that did not appear to be contaminated (for example, no sheen) was discharged to the ground surface at a distance 50 feet or more from any wells. Used PPE was double-bagged and disposed of as general refuse.

2.9.2 Phase II

Based on results of Phase I that showed that wells A-1, C-5, C-6, C-7, C-8, and C-13 were contaminated, all purge water for these wells was containerized, as specified in Section 7.0 of the FSP (BCOE, 1997). In addition, drilling, development, and purge water from the bedrock wells (C-14 and C-15) adjacent to contaminated wells C-6 and C-7 was containerized. For all other wells, purge water was discharged on the ground surface at least 50 feet from the wells. Soils cuttings from C-14 and C-15 exhibited no evidence of contamination and were spread out on the ground surface near the boreholes. Used PPE was double-bagged and disposed of as general refuse.

2.10 Sample Documentation and Handling

Samples were placed in containers that were pre-cleaned, had Teflon-lined seals, were supplied by the laboratory, and were properly labeled. Sample containers, where appropriate, were supplied by the laboratory with the proper preservative. The sample containers were placed in a cushioned cooler and surrounded by enough double-bagged ziploc bags of ice to maintain a temperature of 4°C during transit. A chain of custody form was strictly followed and included with the cooler during shipment. All sample documentation and handling were performed in accordance with Sections 5.0 and 6.0 of the FSP (BCOE, 1996, 1997).

2.11 Decontamination Procedures

Upon completion of activities at each sampling location, all drilling equipment, well materials, and sampling equipment were decontaminated in accordance with Section 4.10 of the FSP (BCOE, 1996) and Section 4.8 of the FSP (BCOE, 1997). Visible soil and debris were removed from augers and tools, and all equipment was sprayed with a hot water high pressure washer, then rinsed with potable water. Pumps used to sample monitoring wells went through a multi-step decontamination process involving wash stages with a non-phosphate detergent, isopropanol, and 0.1 N nitric acid, each of which was followed by a rinse with deionized water.

2.12 Deviations from the Work Plan

2.12.1 Phase I

There were several significant deviations from the work plan during this investigation. TB-1 was eliminated as an environmental sampling hole due to its location (Figure 2-2). TB-1 was at approximately the same elevation as C-13 which was in disintegrated rock. Given that the test borings were designed for soil sampling, TB-1 was eliminated when it appeared it would have been completed in disintegrated rock. Monitoring well C-14, originally planned as a flush mount well inside Building 550, was not installed, because contracting work going on in the building limited access during the drilling program. Chemical samples were not taken from the floor drains inside of Building 500 (Figure 2-2) due to a concurrent investigation done by Target.

Scheduled drilling of wells C-7 and C-8 had to be adjusted due to an unexploded ordnance (UXO) report that later proved to be unfounded. An object that was believed to be a UXO was found by a member of the field crew. All field activity was suspended until the proper authorities had been notified and the area was cleared. The ALC Environmental staff was notified of the situation, the object was examined and found to be insignificant, and work resumed at the site.

The final deviation from the work plan was the additional residential well sample as described in Section 2.8.1 above.

2.12.2 Phase II

Significant deviations from the work plan occurred during groundwater sampling. Low flow purging and sampling was the specified method, but could not be achieved for wells A-1, A-2, C-11, C-13, C-14, and C-15. Wells C-13 and A-1, with extremely low recharges rates and an inadequate column of water for the pump, were bailed dry and allowed to recharge before collecting samples with a disposable bailer. Well A-2 was pumped dry, then allowed to recharge and sampled with a pump. The bedrock wells, C-11, C-14, and

C-15, had insufficient recharge rates to allow low flow purging and sampling. The bedrock wells were sampled by pumping at the lowest rate possible, but one that still produced continuousdrawdown.

During Round 1 sampling of C-14 and C-15, the pH meter was not operating properly, and a backup meter was not available. Round 2 sampling revealed unusually high pH (12.9) values for C-14. High pH was confirmed by two additional instruments. The pH values for C-15 were normal. It is believed that the high pH in C-14 was a reflection of a leaky grout seal. To ensure a proper seal, three Neoprene packers were attached to the end of 2-inch PVC riser pipe and placed into the well to a depth of 72 feet. The annular space—between the 2-inch and 4-inch PVC riser pipe and between the 2-inch PVC and open hole bedrock well—was filled with cement-bentonite grout (see Appendix B for modifications to well design). Subsequent well purging results are consistent with the presence of an effective packer-grout seal.

One deviation occurred during Round 1 surface water sampling: the oil/water separator sample was taken from the effluent tank, not from the end of the effluent discharge pipe as specified in the work plan. It was deemed more prudent to take the sample closer to the source, rather than from a distal point that would have experienced additional transport and volatilization. As discussed in Section 2.6.2, construction of an air stripper to treat effluent from Building 500 removed the necessity of sampling the oil/water separator during Round 2.

3.0 CHARACTERISTICS OF STUDY AREA

3.1 Location

ALC is located adjacent to the Hillandale Community of Adelphi, Maryland, a residential and commercial suburb of the Washington, D.C. Metropolitan area (Figure 1-1). The facility is approximately 5 miles from Washington, D.C.

3.2 Meteorology

Weather conditions for the site are variable and are characterized by four distinct seasons. The weather patterns are influenced by the Chesapeake Bay and Atlantic Ocean to the east and the Appalachian Mountains to the west. Winter is characterized by cold, dry, continental-polar winds from the west and northwest (BCOE, 1980). Summer is characterized by maritime-tropical winds from the south and southwest which bring warm, humid air to the region. It is common for high pressure systems to stagnate over the area and create periods of elevated air pollution for the region.

Mean monthly temperatures range from a low of 36 ^{o}F in January to a high of 75 ^{o}F in July. The record temperatures range from -15 ^{o}F to 106 ^{o}F. Average annual precipitation is 45 inches. Snowfall averages 20 inches annually. Relative humidity ranges from 50 to 80 percent.

3.3 Physiography

The site lies within the Coastal Plain physiographic province, just to the east of the Fall Line which divides the Coastal Plain Province from the Piedmont. The topography is gently rolling to hilly with rock outcroppings. Elevations range from approximately 135 to 320 feet above sea level. The installation is drained by Paint Branch Creek, which flows across the area in a southeasterly direction. A small unnamed tributary flows from the west through ALC and into Paint Branch Creek. The watershed is part of the Anacostia River Basin. The Paint Branch Creek flows into the Northeast Branch of the Anacostia River approximately 4 miles southeast of ALC. The Anacostia River eventually drains into the Potomac River. Portions of the installation are heavily wooded.

3.4 Geology

The geologic map of Maryland indicates the site is underlain by Cretaceous age soils belonging to the Potomac Group (Maryland Geological Survey, 1968). Locally, in low-lying areas, Lowland sand and gravel deposits of Pleistocene age may overlie Potomac Group deposits. The Cretaceous soils form the base of the Coastal Plain formations and directly overlie the bedrock formations that outcrop to the west of the Fall Line. Erosion along the stream valleys has cut through the Pleistocene and Cretaceous age materials exposing the underlying bedrock and deeply weathered residual materials.

The bedrock beneath the site is a gneiss, belonging to the Wissahickon Formation (Maryland Geological Survey, 1968), a metamorphic rock of early Paleozoic age. The bedrock is typically deeply weathered where exposed and is blanketed by a mantle of residual soils. The residual soils, which develop from in-place weathering of the parent bedrock, are typically low plasticity silty sand and sandy silt that grade into unweathered rock with depth. Harder portions of the residual soils are classified as disintegrated rock and possess characteristics of soft rock. Regionally, foliation within the bedrock strikes northward and generally dips to the west at 50-60 degrees.

Results of the subsurface investigation are provided on the boring logs in Appendix A. The borings indicate the Coastal Plain deposits consist of clayey gravels (GC), poorly graded sands (SP), silty sands (SM), clayey sands (SC) and lean clays (CL). Locally, the unconsolidated granular deposits of the Pleistocene and Cretaceous are difficult to distinguish visually. The Coastal Plain deposits occur in the high ground areas of the site and reach a maximum thickness of 33 feet in boring C-5. Residual soils, decomposed rock and bedrock occur below the Coastal Plain deposits and extend to the maximum depths investigated. Residual materials were present at the ground surface in test borings for monitoring wells C-12 and C-13. The residual soils indicated on the logs consist of silty sand (SM) and sandy silt (ML), generally with mica and rock fragments. These materials increase in density with depth and grade into decomposed rock and unweathered, competent rock. Rock was core drilled in the test borings drilled for monitoring wells C-11, C-12, C-14, and C-15. Rock core showed a greenish-gray to greenish-black gneiss with varying amounts of quartzite. The rock was highly to moderately weathered in the upper 5 to 10 feet and slightly weathered to unweathered below the upper 10 feet. Recovery was generally very good (greater than 90%), except in the upper 4 feet at C-11 where recovery varied from 0 to 9% and the upper 8 feet at C-14 (0-87%).

Bedrock was encountered in C-11 at about 25 feet below grade (elevation of 162 ft) and at C-12 at about 21 feet below grade (elevation of 168 ft). The residual soil/decomposed rock ranged in thickness from approximately 15 feet at C-11 to 18 feet at C-12. At both C-14 and C-15, bedrock was encountered at 51 feet below grade, corresponding to an elevation of 182 feet for C-14 and 170 feet for C-15. Residual soil/decomposed rock thickness was approximately 26 feet at C-14 and C-15.

Cross sections A-A' and B-B' are oriented East-West and North-South, respectively (Figure 3-1). The two geologic cross-sections were generated using borings from this field investigation (Figures 3-2 and 3-3). The cross-sections show the thickness of the Coastal Plain deposits and residual soil/decomposed rock range in thickness from about 20.5 feet (C-12) to approximately 51 feet at C-14 and C-15.

Sixteen geotechnical samples were collected from eight of the boreholes drilled during this investigation (Table 3-1). The geotechnical samples range from clayey sands (SC) to poorly graded gravels (GP) to silty gravels (GP-GM). Soil samples that were believed to have high hydraulic conductivity values were selected for geotechnical sampling. The geotechncial sampling was biased towards more permeable materials to provide information on the geologic units that provide flow paths for any potential contaminants. Additionally, most of the geotechnical samples were tested for organic material. As determined from loss on ignition, the organic content of the samples ranged from a low of 0.2% to a high of 3.5% (Table 3-1). The geotechnical results are presented in Appendix C.

3.5 Hydrogeology

Groundwater within the region occurs under unconfined or water table conditions. Within the residual soils and Coastal Plain deposits, groundwater occurs in pore spaces in the soil (primary porosity). Within the bedrock there are no pore spaces in the rock matrix, and groundwater occurs in fractures (secondary porosity). Semiconfined conditions may occur along bedrock fractures.

Permeability of Coastal Plain deposits is typically anisotropic. Due to the nature of depositional processes, permeability is usually greater in the horizontal direction than in the vertical direction. Within the residual soils, permeability is also anisotropic and shows higher permeability parallel to the strike of the foliation. As a function of weathering, permeability in residual soils also increases with depth and reaches a maximum near the bedrock-soil interface. Permeability within the bedrock decreases with depth, as fracture spacing tends to increase and joints become tighter with depth. The thickness of the bedrock aquifer is ill-defined. Water bearing fractures may occur at depths of 300 feet or greater, but the bulk of the groundwater flow typically occurs in the upper 50 to 100 feet of highly to moderately fractured bedrock.

Flow pathways within the bedrock are tortuous on a small scale (tens of feet). However, on a somewhat larger scale, flow through the bedrock (and contaminant transport) is topographically controlled and is analogous to flow through a porous medium.

Groundwater in the Building 500 Area has been observed in the Coastal Plain deposits and the bedrock Wissahickon Formation. The Coastal Plain deposits and the crystalline rocks of the Wissahickon Formation behave as a single, interconnected, water-bearing unit. In general, the water table is a subdued reflection of the surface topography. Water levels on the site range from 164 ft to 220 ft above mean sea level and from approximately 4 to 25 ft below grade.

3.5.1 Coastal Plain Hydrogeology

Locally, the unconsolidated sands, silty sands and clays of the Coastal Plain deposits are too thin to constitute a useable aquifer. The Pleistocene and Cretaceous deposits within the Coastal Plain are hydrogeologically interconnected. Hydraulic conductivity tests (slug tests) were performed in wells A-4, C-6, C-7, C-8 , C-11 and C-12. Estimates of hydraulic conductivity obtained from monitoring wells C-6, C-7, C-8, and C-12 ranged from approximately 1.7 to 6.2 ft/day. The calculated hydraulic conductivity values are summarized in Table 3-2. Slug test data obtained in monitoring wells A-4 and C-6 were of *poor quality, and no estimates of hydraulic conductivity were calculated. The slug test data indicate the* Coastal Plain deposits are of low to moderate hydraulic conductivity. The slug test results are presented in Appendix D.

In situ borehole permeability tests were conducted at three intervals in borehole C-9. Calculated hydraulic conductivity values range from 0.01 to 0.35 ft/day, with an average of 0.17 ft/day. The calculated hydraulic conductivity values are summarized in Table 3-2. The in situ borehole permeability test results are presented in Appendix E.

The difference in hydraulic conductivities obtained from in situ permeability tests and slug tests, roughly two orders of magnitude, may reflect the different zones of investigation in the two methods. Unlike slug tests, which get responses from the entire saturated screen interval, in situ borehole tests stress a much smaller vertical section of the aquifer. For homogeneous aquifer materials, the results of the two test methods should be similar. For vertically heterogeneous aquifer materials, as at the Building 500 Area, the differences can be considerable. The responses from slug tests in the Building 500 Area, in materials ranging from silt and clay to gravel, were somewhat biased towards the higher conductivity gravels. The in situ borehole tests at C-9 stressed 1.5 foot intervals with a significant clay component.

3.5.2 Bedrock Hydrogeology

Hydrogeologic information on the bedrock at the Building 500 Area is limited but consistent. Monitoring wells C-11, C-14, and C-15 are the only wells completed in the bedrock. Slug tests were performed in all three bedrock wells (Table 3-2 and Appendix D). Due to extremely slow response no estimate of hydraulic conductivity could be calculated for C-11. However, the slow response of the well suggests the hydraulic conductivity of the bedrock at C-11 is extremely low. The well screen for C-11 was placed in bedrock that was very competent with little or no fractures in the core samples. Fractures in the screened portion of the borehole did not show iron staining that would indicate significant groundwater flow through the fractures.

Because of very slow response, slug tests at C-14 and C-15 were terminated after approximately 30% recovery, instead of the desired 80-90% recovery. However, the calculated hydraulic conductivity values (10^{-3} ft/day; Table 3-2) are reasonable for slightly fractured metamorphic rock (Heath, 1983).

As an additional means of detecting zones of water movement within the bedrock wells, geophysical logs of temperature, differential temperature, and flow were obtained for wells C-14 and C-15 (Appendix A). Abrupt changes in water temperature (most noticeable when displayed as differential temperature) may be indicative of water flowing into the well from fractures. The probe used to monitor flow records vertical flow velocities. Neither the temperature nor the flow logs indicate appreciable flow within the wells (Appendix A).

Three residential wells ([redacted] [redacted] and [redacted] are located near the site and are completed in the bedrock unit. The State of Maryland and Prince George's County Health Department, Division of Environmental Health, Water Quality & Septic Systems provided well records for the [redacted] and [redacted] residential wells (Appendix B). A record for the [redacted] well, which is thought to have been installed in the 1940's, was not available.

The State of Maryland well completion report indicates that the [redacted] well has a surface casing grouted in place from 0-43 feet below grade and is an open-hole bedrock well from 43-200 feet. The completion record indicates that the well had 127 feet of drawdown after 3 hours of pumping at 5 gallons per minute (gpm). The specific capacity of the [redacted] well is approximately 0.04 gpm/ft of drawdown. State well records indicate that the [redacted] well was installed with a surface casing grouted in place from 0-20 feet below grade and is an open-hole bedrock well from 20-205 feet. State well records indicate the [redacted] well showed 160 feet of drawdown after 3 hours of pumping at 3 gpm. The specific capacity of the [redacted] well is approximately 0.02 gpm/ft of drawdown.

The borehole logs, geophysical logs, limited slug test data, and the specific capacity estimates for the residential wells indicate that the hydraulic conductivity of areas in the bedrock for which data are available is very low. There may be zones of higher conductivity, but, if so, they have not been encountered during this investigation. Contaminant transport is highly dependent on the quantity and interconnectedness of bedrock fractures. Data from the three bedrock wells suggest that off-site migration of any contaminants present in bedrock would occur at an exceedingly slow rate.

3.5.3 Groundwater Flow Direction

Groundwater elevation maps were constructed from water table elevation data collected on 13 August 1996, 24 February 1997, and 27 May 1997 (see Table 3-3 and Figures 3-4, 3-5 and 3-6). The 1997 data include five Site 9 wells located on NSWC property. Highest groundwater levels are found in the February data (Figure 3-5). All three periods exhibit similar groundwater flow patterns. The general groundwater flow direction is to the south towards Paint Branch Creek. Discharge areas in the Building 500 Area include unnamed streams east and west of the area, the Site W swale, a small stream to the west of the [redacted] residence, and Paint Branch Creek. All of the small, unnamed streams flow into Paint Branch Creek. During Phase I of this investigation no flow was noted in the Site W drainage swale (east of Building 500) north of Floral Drive. Stream flow was observed in the swale south of Floral Drive and in Paint Branch Creek. During Phase II all streams and creeks were flowing.

In the immediate vicinity of Building 500 the floor slab subdrainage system suppresses the water table, as shown by the significant gradient increase to the north and east of the former tank locations (Figures 3-4 to 3-6). Unchanging groundwater levels in well C-13 indicate that groundwater head beneath Building 500 is constant. The subdrainage system intercepts some upgradient groundwater flow. The subdrainage system discharges to the oil/water effluent separator and eventually to Paint Branch Creek.

Using February data, flow paths have been constructed for several locations to illustrate expected downgradient migration of contaminants, as well as to point towards potential upgradient sources (Figure 3-7). Groundwater intercepting well C-8, the easternmost monitoring well, should discharge to the Site W swale and from there flow into Paint Branch Creek. Based on the relationship between surface topography and potentiometric surface, groundwater in the area approximately 200 feet east of C-8 should flow towards the unnamed stream south of Floral Drive. Both of these flow paths converge on NSWC property when traced upgradient.

A similar situation exists near the western boundary of the Building 500 Area (Figure 3-7). Groundwater passing well C-5 straddles a groundwater divide. Flow downgradient of C-5 would be governed by the exact shape of the divide, which is not adequately defined by current data. Groundwater may flow towards well C-10 or well 9GW74. From C-10 groundwater would be expected to flow towards and perhaps discharge into the unnamed stream west of the [redacted] residence. Groundwater at 9GW74 flows to the unnamed stream west of the Building 500 Area. At some unknown distance west of well C-5, groundwater should discharge to the unnamed stream west of the Building 500 Area.

Groundwater in the vicinity of well C-6 flows towards and beneath Building 500 (Figure 3-7). Groundwater intercepted by the subdrainage system would be discharged from the oil/water separator effluent pipe and would flow into the small stream west of the [redacted] residence. Any groundwater not intercepted by the Building 500 subdrainage system would continue east of well A-4 and then discharge either to the streams flowing past the [redacted] residence or directly into Paint Branch Creek.

3.5.4 Hydraulic Gradients and Seepage Velocity

The groundwater elevation map for 24 February 1997 was used to calculate horizontal gradients across the site. The gradient observed in the water table ranges from approximately 0.18 ft/ft north-northeast of the former tank locations to approximately 0.07 ft/ft (from well C-6 to Building 500) and 0.05 ft/ft (parallel to the southwest side of Building 500 near A-2). The exceptionally high groundwater gradient observed immediately north and east of Building 500 is caused by the underdrain around the former tank pit and the subdrainage system in Building 500.

Head differences in overburden/bedrock well pairs indicate a strong downward gradient (Table 3-3). For example, the head difference for the A-4/C-11 well pair for 24 February 1997 was 4.0 feet. The downward gradient suggests that this well pair is located in a recharge area relative to the major local discharge location, Paint Branch Creek. Furthermore, a downward gradient introduces the possibility that contaminants in the overburden will migrate into bedrock portions of the aquifer. Such migration would, however, be controlled by the quantity and interconnectedness of fractures in bedrock. Data from bedrock core holes indicate that fractures are relatively uncommon, and the potential for contaminant migration into bedrock is low.

Groundwater flow velocity in the Coastal Plain deposits and residual soils can be estimated using hydraulic conductivity, hydraulic gradient and effective porosity. Using Darcy's law:

$$v = \frac{Ki}{n}$$

where:

v = groundwater seepage velocity (ft/day)

K = hydraulic conductivity (ft/day)

i = hydraulic gradient (ft/ft)

n = effective porosity

The average hydraulic conductivity obtained from slug and in situ permeability testing is approximately 3.4 ft/day. Bedrock wells were excluded from the average, and the in situ tests were averaged to obtain a single conductivity value for C-9. The effective porosity for a sand can be estimated at 0.25 (Freeze and Cherry, 1979). Using the groundwater gradients previously discussed, the seepage velocity is approximately 0.68-2.4 ft/day. The seepage velocity is an estimate for advective transport only and does not account for dispersion, retardation or biodegradation processes that are known to occur in the field and decrease contaminant concentrations.

4.0 NATURE AND EXTENT OF CONTAMINATION

4.1 Soil

4.1.1 UST Borings

No VOCs or SVOCs that exceeded soil screening levels derived from EPA Soil Screening Guidance: Technical Background Document (EPA/540/R-95/128) were detected in UST boring samples TB-2, TB-3 and TB-4 (Table 4-1). At soil boring TB-3, the VOCs m-xylene and p-xylene, reported as m,p-xylene, were detected below the soil screening level of 156,429 mg/kg at a combined concentration level of 0.011 mg/kg. Pesticides/PCBs, explosives, and metals were not suspected in these areas and were not tested.

4.1.2 Blowdown Area

Summary results of laboratory analyses on the BDA sample are shown in Table 4-1. VOCs were not detected in the BDA sample. One SVOC, bis(2-ethylhexyl)phthalate (BEHP), was detected at a level of 3.7 mg/kg. BEHP is a common laboratory contaminant and is believed to be unrelated to contaminants at the site. No pesticides/PCBs or explosives were detected, and no metals were above EPA soil screening levels.

4.2 Surface Water and Sediment

4.2.1 Surface Water—Phase I

Results of laboratory analyses for surface water samples SW-1, SW-2, and SW-3 are listed in Table 4-2. Two samples contained TCE above the 5 μg/l limit established in MD Ambient Water Quality Criteria (AWQC) for human health ingestion of drinking water. Sample SW-1 from the stream near the [redacted] residence had a TCE level of 12 μg/l, and sample SW-3 from the swale behind Building 500 had a TCE level of 8 μg/l (Figure 4-1). Cis-1,2-Dichloroethene (cis-1,2-DCE) was detected in sample SW-3 at 7 μg/l. There are no AWQC for cis-1,2-DCE, but the concentration is below the tap water RBC of 61 μg/l. Sample SW-1 also contained 5 μg/l of 1,1,2,2-tetrachloroethane (1,1,2,2-PCA), which is greater than the EPA AWQC of 0.17 μg/l. No SVOCs, pesticides/PCBs, or explosives were detected. No metals were detected above screening levels in either dissolved or total metal fractions of surface water samples, with the exception of total Pb in SW-3. The concentration of Pb in SW-3 was 12 μg/l, which is above the chronic effects limit of 3.2 μg/l for fresh water aquatic life in MD AWQC.

4.2.2 Sediment—Phase I

Results of laboratory analyses for sediment samples SD-1, SD-2, and SD-3 are listed in Table 4-1. One VOC, TCE, was detected at a level of 0.007 mg/kg in the off post sample SD-1, which is below the EPA soil screening level of 58.2 mg/kg. No other VOCs, SVOCs, pesticides/PCBs, or explosives were detected in any of the sediment samples. No metals were detected above EPA soil screening levels.

4.2.3 Surface Water—Phase II

Two samples contained VOCs above the 5 μg/l limit established in MD AWQC for human health ingestion of drinking water. The results of the water sample collected from the oil water separator (OWS) had a TCE level of 120 μg/l which was the same (within laboratory duplicate precision +/-15%) as the Round 1 (May 1997) surface water sample SW-3 (140 μg/l) collected from the Site W drainage swale, behind Building 500 (Table 4-2; Figure 4-1). SW-3 in Round 2 (August 1997) had 210 μg/l TCE.

The samples OWS and SW-3 also had similar levels of cis-1,2-dichloroethene (21 µg/l and 18 µg/l) and 1,1,2,2-PCA (11 µg/l and 12 µg/l), respectively. The sample collected at SW-2 further downstream of Site W and SW-3 detected 1,1,2,2-PCA (3 µg/l) and trichloroethene (4 µg/l). The samples collected at SW-1 downstream of the OWS discharge point were non-detect during Round 1, but 1,1,2,2-PCA (2 µg/l) and TCE (10 µg/l) were above screening levels in Round 2.

The Round 1 surface water sample collected from OWS had BEHP (18 µg/l) and benzo(a)pyrene (3 µg/l). These concentrations are above their respective EPA AWQC for consumption of water and organisms. No SVOCs were detected above regulatory levels in the surface water samples collected downstream of the OWS discharge in sampling Rounds 1 or 2.

The explosive organic compounds HMX (0.55 µg/l), RDX (1.67 µg/l), 2,4,6-TNT (0.65 µg/l) and 4-amino-2,6-DNT (0.45 µg/l) were detected in the Round 1 surface water sample SW-3 but not in the sample collected from the OWS (Table 4-2; Figure 4-2). The sample collected downstream at SW-2 detected HMX (0.6 µg/l) and RDX (0.9 µg/l). The explosive organic compounds HMX (1.0 µg/l), RDX (1.9 µg/l), 2,4,6-TNT (0.9 µg/l) and 4-amino-2,6-DNT (1 µg/l) were detected in the Round 2 surface water sample SW-3 (Table 4-2; Figure 4-2). The sample collected downstream at SW-2 detected HMX (1.2 µg/l), RDX (2.2 µg/l) and 4-amino-2,6-DNT (1.2 µg/l). MCLs have not been established for explosive compounds, but EPA risk-based concentrations (RBCs) have been published for HMX, RDX, and TNT. Concentrations of explosives in surface water were above the RBC for RDX (0.61 µg/l), but below for HMX (1800 µg/l) and TNT (2.2 µg/l). No explosive compounds were detected in the samples collected from the OWS or downstream SW-1.

The metals lead (142 µg/l), nickel (140 µg/l), and cadmium (4.9 µg/l) were detected in the unfiltered OWS sample above MD AWQC (Table 4-2).

No TPH-diesel range were detected surface water samples with the exception of the OWS (31,000 µg/l).

4.2.4 Sediment—Phase II

Results of laboratory analyses for sediment samples SD-1, SD-2, and SD-3 are listed in Table 4-1. The highest TCE level in the Round 1 sampling was detected in the duplicate for SD-3 (0.035 mg/kg), which decreased in the sample collected further downstream at SD-2 (0.002 mg/kg). The only other VOC detected was cis-1,2-dichloroethene, which was detected at SD-3 (0.077 mg/kg). The highest TCE level in the Round 2 sampling was also detected in the sample collected at SD-3 (0.042 mg/kg), which was not detected in the sample collected further downstream at SD-2. The other VOCs detected were 1,1,2,2-tetrachloroethene (0.003 mg/kg) and 1,2-dichloroethene, total (0.006 mg/kg), which was detected at SD-3. All 1,1,2,2-tetrachloroethene, trichloroethene and 1,2-dichloroethene levels were below the EPA soil screening levels of 3.2 mg/kg, 58.2 mg/kg and 782 mg/kg, respectively (Table 4-1).

4.0 NATURE AND EXTENT OF CONTAMINATION

4.1 Soil

4.1.1 UST Borings

No VOCs or SVOCs that exceeded soil screening levels derived from EPA Soil Screening Guidance: Technical Background Document (EPA/540/R-95/128) were detected in UST boring samples TB-2, TB-3 and TB-4 (Table 4-1). At soil boring TB-3, the VOCs m-xylene and p-xylene, reported as m,p-xylene, were detected below the soil screening level of 156,429 mg/kg at a combined concentration level of 0.011 mg/kg. Pesticides/PCBs, explosives, and metals were not suspected in these areas and were not tested.

4.1.2 Blowdown Area

Summary results of laboratory analyses on the BDA sample are shown in Table 4-1. VOCs were not detected in the BDA sample. One SVOC, bis(2-ethylhexyl)phthalate (BEHP), was detected at a level of 3.7 mg/kg. BEHP is a common laboratory contaminant and is believed to be unrelated to contaminants at the site. No pesticides/PCBs or explosives were detected, and no metals were above EPA soil screening levels.

4.2 Surface Water and Sediment

4.2.1 Surface Water—Phase I

Results of laboratory analyses for surface water samples SW-1, SW-2, and SW-3 are listed in Table 4-2. Two samples contained TCE above the 5 µg/l limit established in MD Ambient Water Quality Criteria (AWQC) for human health ingestion of drinking water. Sample SW-1 from the stream near the [redacted] residence had a TCE level of 12 µg/l, and sample SW-3 from the swale behind Building 500 had a TCE level of 8 µg/l (Figure 4-1). Cis-1,2-Dichloroethene (cis-1,2-DCE) was detected in sample SW-3 at 7 µg/l. There are no AWQC for cis-1,2-DCE, but the concentration is below the tap water RBC of 61 µg/l. Sample SW-1 also contained 5 µg/l of 1,1,2,2-tetrachloroethane (1,1,2,2-PCA), which is greater than the EPA AWQC of 0.17 µg/l. No SVOCs, pesticides/PCBs, or explosives were detected. No metals were detected above screening levels in either dissolved or total metal fractions of surface water samples, with the exception of total Pb in SW-3. The concentration of Pb in SW-3 was 12 µg/l, which is above the chronic effects limit of 3.2 µg/l for fresh water aquatic life in MD AWQC.

4.2.2 Sediment—Phase I

Results of laboratory analyses for sediment samples SD-1, SD-2, and SD-3 are listed in Table 4-1. One VOC, TCE, was detected at a level of 0.007 mg/kg in the off post sample SD-1, which is below the EPA soil screening level of 58.2 mg/kg. No other VOCs, SVOCs, pesticides/PCBs, or explosives were detected in any of the sediment samples. No metals were detected above EPA soil screening levels.

4.2.3 Surface Water—Phase II

Two samples contained VOCs above the 5 µg/l limit established in MD AWQC for human health ingestion of drinking water. The results of the water sample collected from the oil water separator (OWS) had a TCE level of 120 µg/l which was the same (within laboratory duplicate precision +/-15%) as the Round 1 (May 1997) surface water sample SW-3 (140 µg/l) collected from the Site W drainage swale, behind Building 500 (Table 4-2; Figure 4-1). SW-3 in Round 2 (August 1997) had 210 µg/l TCE.

The samples OWS and SW-3 also had similar levels of cis-1,2-dichloroethene (21 µg/l and 18 µg/l) and 1,1,2,2-PCA (11 µg/l and 12 µg/l), respectively. The sample collected at SW-2 further downstream of Site W and SW-3 detected 1,1,2,2-PCA (3 µg/l) and trichloroethene (4 µg/l). The samples collected at SW-1 downstream of the OWS discharge point were non-detect during Round 1, but 1,1,2,2-PCA (2 µg/l) and TCE (10 µg/l) were above screening levels in Round 2.

The Round 1 surface water sample collected from OWS had BEHP (18 µg/l) and benzo(a)pyrene (3 µg/l). These concentrations are above their respective EPA AWQC for consumption of water and organisms. No SVOCs were detected above regulatory levels in the surface water samples collected downstream of the OWS discharge in sampling Rounds 1 or 2.

The explosive organic compounds HMX (0.55 µg/l), RDX (1.67 µg/l), 2,4,6-TNT (0.65 µg/l) and 4-amino-2,6-DNT (0.45 µg/l) were detected in the Round 1 surface water sample SW-3 but not in the sample collected from the OWS (Table 4-2; Figure 4-2). The sample collected downstream at SW-2 detected HMX (0.6 µg/l) and RDX (0.9 µg/l). The explosive organic compounds HMX (1.0 µg/l), RDX (1.9 µg/l), 2,4,6-TNT (0.9 µg/l) and 4-amino-2,6-DNT (1 µg/l) were detected in the Round 2 surface water sample SW-3 (Table 4-2; Figure 4-2). The sample collected downstream at SW-2 detected HMX (1.2 µg/l), RDX (2.2 µg/l) and 4-amino-2,6-DNT (1.2 µg/l). MCLs have not been established for explosive compounds, but EPA risk-based concentrations (RBCs) have been published for HMX, RDX, and TNT. Concentrations of explosives in surface water were above the RBC for RDX (0.61 µg/l), but below for HMX (1800 µg/l) and TNT (2.2 µg/l). No explosive compounds were detected in the samples collected from the OWS or downstream SW-1.

The metals lead (142 µg/l), nickel (140 µg/l), and cadmium (4.9 µg/l) were detected in the unfiltered OWS sample above MD AWQC (Table 4-2).

No TPH-diesel range were detected surface water samples with the exception of the OWS (31,000 µg/l).

4.2.4 Sediment—Phase II

Results of laboratory analyses for sediment samples SD-1, SD-2, and SD-3 are listed in Table 4-1. The highest TCE level in the Round 1 sampling was detected in the duplicate for SD-3 (0.035 mg/kg), which decreased in the sample collected further downstream at SD-2 (0.002 mg/kg). The only other VOC detected was cis-1,2-dichloroethene, which was detected at SD-3 (0.077 mg/kg). The highest TCE level in the Round 2 sampling was also detected in the sample collected at SD-3 (0.042 mg/kg), which was not detected in the sample collected further downstream at SD-2. The other VOCs detected were 1,1,2,2-tetrachloroethene (0.003 mg/kg) and 1,2-dichloroethene, total (0.006 mg/kg), which was detected at SD-3. All 1,1,2,2-tetrachloroethene, trichloroethene and 1,2-dichloroethene levels were below the EPA soil screening levels of 3.2 mg/kg, 58.2 mg/kg and 782 mg/kg, respectively (Table 4-1).

With the exception of benzo(a)pyrene, no SVOCs or explosives were detected in any of the sediment samples above EPA soil screening levels. Benzo(a)pyrene was detected at 1.0 mg/kg during Round 2 at SD-1 and 0.81 mg/kg during Round 1 and SD-2 (Table 4-1). TPH-DRO was detected at levels ranging from 88 mg/kg (SD-2) to 240 mg/kg (SD-3 duplicate). TPH-DRO was not found in SD-1.

Metals were not detected above EPA soil screening levels (Table 4-1).

4.3 Groundwater

Chemical analyses of groundwater samples analyzed during this investigation are summarized in Table 4-3. VOCs, SVOCs, metals (total and dissolved) and explosives were detected in groundwater samples.

4.3.1 Volatile Organic Compounds—Phase I

TCE was the only VOC detected in the groundwater above MCLs (Table 4-3). The MCL for TCE of 5 µg/l was equaled or exceeded in monitoring wells A-1, C-6, C-7, C-8, and C-13 (Figure 4-1). The volatile 1,1,2,2-PCA exceeded THE RBC of 0.052 µg/l in monitoring wells C-6 and C-7. Some combination of the VOCs cis-1,2-DCE, 1,1,1-trichloroethane (TCA), and toluene was detected in monitoring wells A-1, C-6, C-7 and C-13 (Table 4-3). No VOCs were detected in the off-site residential wells.

The spatial distribution of TCE in the groundwater indicates that the source of the contamination is located upgradient of Building 500 (Figure 4-1). TCE is a member of the chlorinated ethene chemical family and can degrade by reductive dehalogenation to cis-1,2-DCE, trans-dichloroethene (trans-DCE) or 1,1-dichloroethene (1,1-DCE) then to vinyl chloride. Dehalogenation is a reduction that involves the breaking of a carbon-halogen bond, with hydrogen then replacing the halogen. The result of the dehalognation reduction is a compound with one less chlorine than its precursor. The TCE degradation byproduct cis-1,2-DCE was detected below the MCL of 70 µg/l in monitoring wells A-1, C-6 (duplicate) and C-7.

The NSWC is located upgradient from Building 500. An RI completed at the NSWC (Malcolm Pirnie, 1992) concluded TCE was present in the groundwater in the vicinity of Site 9. The RI-NSWC also concluded that the groundwater flow is to the south-southeast.

Toluene was detected in well C-13. Previous incidental spillage of petroleum products during industrial applications inside Building 500 is likely the source for the toluene contamination.

4.3.2 Volatile Organic Compounds—Phase II

During the Round 1 sampling TCE exceeded the MCL of 5 µg/l in the following monitoring well samples: A-1, A-2, C-6, C-7, C-8, C-13 and C-14 (Figure 4-1; Table 4-3). TCE contamination in C-14 is probably the result of cross-contamination due to a faulty grout seal (see Section 2.12.2). TCE was found at a level below the MCL at well A-4 (1 µg/l). No VOCs were detected in the off-site residential wells. The VOC 1,1,2,2-PCA was above the RBC guidance level of 0.052 µg/l in monitoring wells A-1, C-6, C-7 and C-8. The VOC cis-1,2-DCE was detected in monitoring wells A-1, A-2, C-6, C-7, C-8, C-13, and C-14. 1,1,1-TCA was detected in monitoring well sample C-13. Toluene was found in C-13 at 13 µg/l, well below the MCL of 1000 µg/l.

The results of the second round of sampling were similar to the first round. In Round 2 TCE exceeded the MCL of 5 µg/l in the samples from the same monitoring wells as Round 1: A-1, A-2, C-6, C-7, C-8, C-13 and C-14 (Figure 4-1; Table 4-3). The VOC 1,1,2,2-PCA was above the RBC guidance level in monitoring wells C-6, C-7 and C-8. The VOC cis-1,2-DCE was detected in monitoring wells A-1, A-2, C-6, C-7, C-8, C-13, and C-14. Toluene and 1,1,1-TCA were detected in monitoring well sample C-13.

4.3.3 Semivolatile Organic Compounds—Phase I

BEHP was the only SVOC detected in groundwater. BEHP was detected above the MCL limit of 6 µg/l in monitoring well samples A-1, A-3, C-6 (duplicate), C-7, C-8 and t[redacted]well sample (Table 4-3). Because BEHP is a known common laboratory contaminant and was detected in the C-6 duplicate but not in the original sample, the presence of the compound is interpreted as laboratory contamination and is not related to site contaminants.

4.3.4 Semivolatile Organic Compounds—Phase II

BEHP was the only SVOC detected in groundwater. BEHP was detected above the MCL of 6 µg/l in monitoring well samples A-2, A-3, A-4, C-5, C-6, C-6 (duplicate), C-7, C-8, C-11 and C-12 (Table 4-3). Because BEHP is a known common sampling and laboratory contaminant, the presence of the compound is interpreted as sampling and laboratory contamination and is not related to site contaminants.

4.3.5 Metals—Phase I

Cadmium (Cd) was the only metal detected in groundwater that exceeded the MCL. Groundwater samples for total cadmium exceeded the MCL of 5 µg/l at A-3 and C-11 (Table 4-3). Dissolved Cd was not detected in these samples. In general, concentrations of dissolved metals are more representative of the water quality in the aquifer than total metals, because total metals concentrations include metals that were associated with suspended solids in the water sample.

The detection limit for thallium (Tl) was 5 µg/l and the MCL is 2 µg/l. Therefore, no conclusion regarding the nature and extent of thallium contamination can be made based on this round of sampling.

4.3.6 Metals and Cyanide—Phase II

Cadmium was the only inorganic compound detected in groundwater samples that exceeded the MCL (Table 4-3). Groundwater samples for cadmium exceeded the MCL of 5 µg/l at A-2 (14 mg/l dissolved and 7.26 mg/l dissolved in Round 1 and 2, respectively).

No thallium was detected in the groundwater samples above the MCL. The reporting limit for thallium during this phase was 0.5 µg/l which is less than the MCL of 2 µg/l.

4.3.7 Explosives—Phase I

No explosive organic compounds were detected in groundwater samples except at monitoring well C-5, where the concentration of RDX was 7.3 µg/l (Table 4-3). No MCL has been established for RDX, however an RBC of 0.61 µg/l has been established.

The RDX contamination at well C-5, which is just inside the ALC property boundary, suggests a possible upgradient source (Figure 4-2). The NSWC, located upgradient of C-5, has a documented history of contamination with nitroaromatic compounds that include HMX, RDX, 2,6-DNT and nitrobenzene (Malcolm Pirnie, 1992).

4.3.8 Explosives—Phase II

Groundwater analysis of the Round 1 sampling detected HMX levels of 1.49 µg/l and 0.72 µg/l at monitoring wells C-5 and C-6, respectively. RDX was detected at a level of 4.68 µg/l in monitoring well

C-5. No MCL has been established for RDX or HMX. The concentrations of HMX are below the EPA RBC level of 1800 µg/l for HMX. The RDX level is above the RBC limit of 0.61 µg/l in monitoring well C-5.

Groundwater analysis of the Round 2 sampling detected HMX levels of 1.6 µg/l and 0.6 µg/l in monitoring wells C-5 and C-8, respectively. RDX was detected in monitoring wells C-5 (5 µg/l) and C-8 (1.0 µg/l). The concentrations of HMX are below the EPA RBC level. However, the RDX levels in monitoring wells C-5 and C-8 are above the RBC limit.

4.3.9 Pesticides and PCBs—Phase I

No pesticides or PCBs were detected in the groundwater at the Building 500 Area.

4.3.10 Pesticides and PCBs—Phase II

Pesticides and PCBs were not included as analytes in Phase II sampling, because they were not found in Phase I.

5.0 CONTAMINANT FATE AND TRANSPORT

The remedial investigation at the Building 500 Area has detected the chlorinated organic compounds trichloroethene (TCE) and 1,1,2,2-tetrachloroethane (1,1,2,2-PCA), the explosive compound RDX, bis(2-ethylhexyl)phthalate (BEHP) and cadmium in the groundwater and/or surface water at levels exceeding the MCL or RBC. Additionally, benzo(a)pyrene has been detected at levels exceeding the SSL in sediment samples from streams on either side of the [redacted] residence. The following discussion details the fate and transport of these contaminants in the environment.

5.1 Chlorinated Organic Compounds

Chlorinated organic compounds are used for vapor degreasing of metals which results in releases to the environment through evaporation, spills, and leaks in storage tanks. Wastewater from metal finishing, paint and ink formulation, electrical/electronic components, and rubber processing industries also contains TCE and 1,1,2,2-PCA.

The VOCs TCE and 1,1,2,2-PCA and associated breakdown products were detected at levels of concern in the groundwater around the Building 500 Area. TCE and 1,1,2,2-PCA were also detected in the effluent of the oil/water separator (OWS) and the surface water samples for the Site W area. Chlorinated organic compounds are suspected carcinogens and can be broken down in the environment by the successive removal of chlorine atoms. The breakdown products are DCE and vinyl chloride, a known carcinogen. There is little or no evidence of vinyl chloride at the Building 500 Area.

5.1.1 Fate of Chlorinated Organic Compounds in the Environment

Chlorinated organic compounds spilt or released to soil will evaporate rapidly due to reasonably high vapor pressures. These compounds will also leach into groundwater rapidly. Low adsorption coefficient ($\log K_{OC} = 2.0$) to a number of soil types indicates ready transport through soil and low potential adsorption to sediments. The mobility in soil is confirmed in soil column studies. TCE appears to be fairly stable in soil, although degradation in groundwater can occur. TCE and its breakdown products are soluble in water to levels greater than 150 mg/l. Infiltrating precipitation will readily carry them to the water table where they will be dissipated by advection and diffusion. Advection is the process of conveying the compounds by the motion of the fluid in which it is contained, whether dissolved or sorbed onto clay particles, in the same manner that sediments are carried along in a flowing stream. Diffusion refers to the tendency of dissolved compounds to flow from an area of higher concentration to an area of lower concentration. This is the same phenomenon that occurs when a drop of dye put in the center of a glass of water eventually colors the entire contents of the glass evenly

In surface water the primary removal process will be evaporation with a half-life of minutes to hours, depending upon turbulence. Biodegradation, hydrolysis, and photooxidation are extremely slow by comparison. Adsorption to sediment and bioconcentration in aquatic organisms are not important processes.

5.2 Explosive Compounds

The explosive compounds Octahydro-1,3,5,7-tetanitro-1,3,5,7-tetrazocine (HMX), Hexahydro-1,2,5-trinitro-1,3,5-triazine (RDX), 2,4,6-Trinitrotoluene (TNT) and 4-Amino-2,6-dinitrotoluene (4-Amino-2,6-DNT) have been detected sporadically in surface water samples SW-3 where the water table intersects the surface upgradient of building 500, which was formerly NSWC property and downstream in SW-2. Of these, only RDX is present in concentrations exceeding the EPA RBC.

5.2.1 Fate of Explosive Compounds in the Environment

Advection and diffusion are the two methods by which explosives can be spread through groundwater. RDX is less soluble in water (solubility = 60 mg/l) than the volatile organic compounds discussed above. The low octanol/water partition coefficient of RDX (K_{OW} = 7.50) indicates that RDX is more mobile than TNT (K_{OW} = 68) and will transport through soil with a low potential adsorption to sediments.

The transformation of TNT can be biotic, abiotic, or a combination. The TNT molecule is biotransformed by reduction of the nitro groups to amino groups by various microorganisms including bacteria, yeast and fungi to form monoaminodinitrotoluene (4-Amino-2,6-DNT). The abiotic transformation of TNT can occur when ferrous chloride or manganous chloride are present.

5.3 Bis(2-ethylhexyl)phthalate

BEHP is used as a plasticizer for polyvinyl chloride (PVC) and other polymers in large quantities and is likely to be released into the air and water during production and waste disposal of these plastic products. Human exposure will occur in occupational settings and from air, consumption of drinking water and food (especially fish, etc., where bioconcentration can occur).

BEHP has been detected in all monitoring wells in either the Phase I or Phase II sampling event. Only in wells A-1 and A-3 has BEHP been found in all rounds of sampling, with the most recent sampling results also associated with detections in the blanks. BEHP has not been detected in surface water or sediment samples.

5.3.1 Fate of BEHP in the Environment

BEHP released to the soil will neither evaporate nor leach into the groundwater. BEHP has a very low vapor pressure and Henry's Law Constant, and therefore, it should not evaporate from soil or water. A calculated half-life of evaporation from water of 15 years has been reported. BEHP has a strong tendency to adsorb to soil and sediments. Calculated log K_{OC} values of 4 to 5 have been reported. Experimental evidence demonstrates strong partitioning to clays and sediments, which reduces the likelihood of leaching into, and transport through, groundwater. Limited data are available to suggest that it may biodegrade in soil under aerobic conditions following acclimation.

Under aerobic conditions, BEHP released into water systems will biodegrade fairly rapidly (half-life 2-3 weeks) following a period of acclimation. It will strongly adsorb to sediments and bioconcentrate in aquatic organisms. Evaporation and hydrolysis are not significant aquatic processes.

5.4 Cadmium

Cadmium has been detected sporadically in some of the wells (A-2, A-3, A-4, and C-11) downgradient of Building 500. Cadmium is also found at concentrations below the SSL of 78.2 mg/kg in downgradient and off-site sediment locations, although it has not been detected in the corresponding surface water samples.

5.4.1 Fate of Cadmium in the Environment

Advection and diffusion are the two methods by which cadmium can be spread through groundwater. Cadmium must dissolve in either the groundwater or in infiltrating water to be transported by advection and diffusion. After being dissolved into the aquifer, cadmium will move downgradient in the groundwater by advection, and toward areas of lower concentration by diffusion. Advection is the primary means by which soluble compounds are transported in the subsurface.

5.5 Benzo(a)pyrene

Benzo(a)pyrene is one of the polynuclear aromatic hydrocarbons (PAHs) associated with petroleum products and is likely to be released in fuel oil spills. Benzo(a)pyrene has been detected once in the Oil Water Separator sample and occasionally in sediment in two different sampling events above the soil screening levels in the sediment samples SD-1 and SD-2.

5.5.1 Fate of Benzo(a)pyrene in the Environment

The partition coefficient K_{OC} for benzo(a)pyrene is 550,000 l/kg (log K_{OC} = 5.74), indicating that it is very persistent in soil and will tend to remain at the location it was deposited. The only opportunity for PAHs to migrate or "creep" in the soil is by dissolution into the groundwater and readsorption to clean soils downgradient in the aquifer. However, the solubility of benzo(a)pyrene is so low and the partition coefficient so high that ppb concentrations picked up by groundwater in the area of high concentration will readsorb quickly to less contaminated soils which are immediately adjacent.

5.6 Contaminant Transport

The highest concentrations of chlorinated solvents and explosive compounds are found in wells upgradient of Building 500, near the boundary with NSWC property or on former NSWC property, which strongly suggests that the source is related to a spill or spills on NSWC property. Once on ALC property, much of the chlorinated solvents enters the underdrain collection system in Building 500 where the underdrain intersects the water table. The absence of explosive compounds in monitoring wells adjacent to and in Building 500 is probably a reflection of the low concentrations upgradient and dilution as the contaminants migrate downgradient. Chlorinated solvents and explosive compounds are also detected in the swale at Site W where the water table intersects the surface. From these locations, they are apparently migrating off-site in the surface water and sediments.

There are two observations that strongly suggest that the presence of BEHP in groundwater samples is the result of either lab or field contamination. The sporadic nature of BEHP detections is not consistent with groundwater contamination. The absence of BEHP in sediment samples at known groundwater discharge points (location SW/SD-3 and to a lesser extent SW/SD-1 and SW/SD-2) is surprising if BEHP contamination exists. Given the tendency of BEHP to adsorb to soil and sediment, there should be concentrations of BEHP in sediment at places where groundwater reaches the surface. Unless future sampling yields a consistent pattern of BEHP contamination, it seems questionable to consider BEHP a contaminant of concern.

The presence of cadmium in downgradient overburden monitoring wells and in C-11, a bedrock well, raises the possibility of off-site migration of cadmium in groundwater and potential discharge to surface water bodies. The absence of cadmium in surface water samples and the [redacted] residential well indicates that this transport is not effective or that cadmium concentrations are diluted to the point of non-detection by the time the cadmium has migrated off-site.

The tendency of benzo(a)pyrene to adsorb to sediments and soils indicates that it should not be expected to transfer to groundwater or surface water and migrate further downgradient. Some migration downgradient may occur through transport of sediment in surface water during high energy events, such as storms.

6.0 BASELINE RISK ASSESSMENT

The purpose of this risk assessment performed for the ALC Building 500 Area is to evaluate human health risks posed by exposure to contaminants from the site. The risk assessment focuses on (a) the contaminants of concern detected during the Phase I (1996) and Phase II (1997) investigations at the site; (b) the applicable or relevant and appropriate requirements (ARARs); (c) the potential environmental pathways by which populations might be exposed to the contaminants released from the site; (d) a toxicity assessment; (e) the estimated intake levels of the contaminants of concern; and (f) the toxicity value of the contaminants of concern. The level of risk that the site poses to human health is then quantified.

6.1 Exposure Assessment

Utilizing the information presented in Section 4.0 (Nature and Extent of Contamination) of the RI Report, there are several contaminants of concern (COC) at the site: trichloroethene (TCE), cadmium (Cd), 1,1,2,2-tetrachloroethane (1,1,2,2-PCA), and hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX) in groundwater; TCE, 1,1,2,2-PCA, and RDX in surface water; and benzo(a)pyrene (BaP) in sediment. The COC were determined by detection of the compounds exceeding regulatory limits and recognized guidance during Phase I and II environmental investigations at the Building 500 Area. Samples were collected from groundwater, soil, surface water, sediment, and residential wells.

Table 6-1 is provided to collectively show the highest detections of the COC and to what regulatory limit/guidance the detection was compared.

6.1.1 Contaminants not Considered as COC

Phase II sampling of the drinking water from the off-site [redacted] family residential well detected inorganic lead (Pb) levels greater than regulatory limits (see Table 4-3). The [redacted] well was sampled from a tap located "upstream" of the residence's water filtration system. With Pb in drinking water associated with the lead solder used to join metal pipes, it is believed that the Pb source for the detection is associated with [redacted] family plumbing system and not activities associated with Building 500 or other Department of Defense activities. Phase I water sampling at the [redacted] residence was performed on the "downstream" side of their filtration system and neither Pb nor other COC were detected. During Phase I and II sampling, no monitoring well (MW) detected Pb levels in GW greater than regulatory limits. Pb in residential well water is not considered a COC, and it was a management decision that Pb will not be considered further in the risk assessment.

BEHP, which is also known as DEHP, was detected in GW during Phase I and II MW sampling with results exceeding regulatory limits (see Table 4-3). BEHP is a manufactured chemical which makes plastic more flexible. BEHP is in polyvinyl chloride (PVC) products, with BEHP making up 40% of vinyl plastic. BCOE MWs used PVC piping, and BEHP is often considered a laboratory contaminant. It is also found in latex sampling gloves used for personal protection. BEHP was detected above regulatory limits in some MWs in Phase I but not detected in the same MWs in Phase II. BEHP was not detected in some Phase I MWs but detected exceeding limits in those same MWs in Phase II. With the investigation area recognized to have GW discharge to surface water, it was noted the BEHP was not detected in sediment or soil boring samples. Considering the above discussion, along with the potential laboratory contamination and contamination from field sampling equipment and practices, BEHP in GW is not considered one of the COC.

6.1.2 Exposure Pathways and Potential Receptors

Human exposure to the identified COC associated with this remedial investigation could potentially occur via exposure pathways. Exposure pathways are the physical courses a chemical takes from the source location to the exposed receptor. An exposure pathway is considered complete when the following occurs:

- a source and mechanism for chemical release is present,
- an intermedia transport mechanism is present if the exposure point differs from source,
- a migration pathway is present,
- an exposure route exists through which the chemical uptake occurs, and
- a receptor group exists that may come into contact with the chemical.

6.1.2.1 Groundwater

This is a potential pathway of concern given that groundwater is an active source of water for household use in the area. Existing GW elevation data indicate that off-site residential wells are [redacted] of the Building 500. The remedial investigation revealed that under current conditions, no COC were detected in the residential wells except for inorganic lead and BEHP. The significance of their detections was discussed in Section 6.1.1 above. For future GW considerations, upgradient to the residential wells were elevated detections of TCE, Cd, RDX, and 1,1,2,2-PCA in GW. These COC potentially could migrate off-site. The potential for future exposure to the COC by means of a GW pathway is considered complete to human receptors by means of well water consumption. Potential receptors of this exposure pathway are residents [redacted] of Building 500.

6.1.2.2 Surface Water

This is a potential pathway of concern given that GW in the vicinity of Building 500 discharges to surface waters (see Section 3.5.3). This is significant because three of the four COC in GW (TCE, RDX, and 1,1,2,2-PCA) were detected at elevated levels in surface waters in the vicinity of Building 500. Two of the sample locations were not on U.S. Army property but downgradient and off the site at different unnamed creeks that feed into Paint Branch Creek. The other location was on Army property at the Site W drainage swale.

Paint Branch Creek and the unnamed creeks near Building 500 are shallow and narrow. As such, they are not locations where swimming or other recreational water activities are expected. However, Paint Branch Creek and its tributaries carry Use III designation in the Code of Maryland Regulation (COMAR) 26.08.02 and are protected for agricultural and industrial use, aquatic life, water contact recreation and fishing, and as natural trout waters. As such, these waters are governed by Maryland and federal ambient water quality criteria for the protection of human health and aquatic life.

Near Building 500, dermal contact with these waters can occur, but incidental ingestion of the surface water is not expected. Because of potential direct contact, the surface water exposure pathway near Building 500 was considered to be a complete exposure pathway to potential human receptors. The potential receptors are nearby residents, trespassers, and Building 500 workers.

6.1.2.3 Direct Contact with Sediment/Soil

This potential pathway of concern is considered to be complete for sediment. Detected levels of BaP were elevated in sediment samples taken from the unnamed streams downgradient of Building 500. The sample location (SD-2) is not on DoD property and is more than 500 feet south and downgradient of the drainage swale sample location. Sample location SD-1 is not on DoD property and is approximately 200 feet southeast and downgradient of the oil water separator (OWS) surface discharge point (Figure 3-7). BaP was detected at the OWS. The risk to human health by the pathway of direct contact with the sediments is considered complete to potential human receptors of residents and trespassers.

Three rounds of soil sampling at the investigation area have resulted in detected contaminant concentrations less than recognized guidance. Therefore, an exposure pathway from soil has been determined to be incomplete for present and potential future human receptors.

6.1.2.4 Air Exposure

The air exposure pathway is of concern when contaminants from water or soil migrate to the atmosphere resulting in exposure to humans via inhalation. Because of the low concentrations of the COC mentioned in the preceding sections, the air exposure pathway outdoors is considered complete but insignificant as a pathway. Indoors, with residential water use, the pathway could be considered significant. Volatilization of contaminants from the GW is considered a viable and complete pathway, even though VOC sampling at the site has resulted in detected levels limited to the µg/l range.

For sediment and soil, wind erosion is considered for surficial soil fugitive dust emissions. Because the site is well vegetated (both on and off Army property), the likelihood of this being a significant exposure pathway is minimal. Wind erosion is normally applicable to disturbed, non-adhering or non-compacted soil. The vegetated soil at the site does not meet these criteria. Potential receptors of this minimal pathway exposure are nearby residents, trespassers, and Building 500 workers.

6.1.3 Concentration Comparison with ARARs and TBC Criteria

Applicable or Relevant and Appropriate Requirements (ARARs) used for groundwater comparisons are the MDE Maximum Contaminant Level (MCL) for chemicals (COMAR 26.04.01.06A &07D) and EPA National Primary and Secondary Drinking Water Standards which also use MCLs. The ARARs used for surface water comparison are the EPA Ambient Water Quality Criteria (AWQC) for human health protection (40 CFR 131.36) and MDE's AWQC for human health protection (COMAR 26.08.02.03-2). A "to be considered" (TBC) guidance criteria is the EPA Region III risk-based concentration table which uses Risk-Based Concentrations (RBCs). The TBC criteria used for soil and sediment comparisons is the EPA Soil Screening Guidance (EPA/540/R-95/128) which uses calculated site-specific Soil Screening Levels (SSLs).

6.1.3.1 Groundwater ARARs

Reviewing Table 4-3 of the RI Report, it is observed that TCE was equal to or exceeded its regulatory MCL in five groundwater monitoring wells (MWs) during Phase I and in seven MWs in Phase II. Levels of Cd were detected in two MWs in Phase I and in one MW in Phase II exceeding its regulatory MCL. No regulatory MCL has been established by MDE or EPA for the chemicals 1,1,2,2-PCA and RDX. Without regulatory limits, the EPA RBC Table will be used as a guidance advisory even though RBCs have no regulatory authority. The RBC for tap water of 1,1,2,2-PCA and RDX were used for comparison purposes. The 1,1,2,2-PCA RBC was exceeded in two MWs in Phase I and in four MWs during Phase II. The RDX RBC was exceeded in one MW in Phase I and two MWs in Phase II. However, it should be recognized that the RBC for 1,1,2,2-PCA is significantly lower than the method detection limit. No Cd, TCE, RDX, or 1,1,2,2-PCA has been detected in nearby residential wells in either Phase I or II.

6.1.3.2 Surface Water ARARs

Reviewing Table 4-2, it is observed that TCE exceeded their regulatory AWQCs in two of the three surface water (SW) sampling locations in Phase I and three of the four SW sampling locations in Phase II. 1,1,2,2-PCA exceeded regulatory AWQC in one of the three sampling locations in Phase I and all four sampling locations in Phase II. Without regulatory guidance for RDX regarding SW, the tap water RBC for RDX was used. RDX exceeded TBC criteria at two sample locations in Phase II. See section 6.1.2.2 for a discussion of Paint Branch Creek's surface water designation and how it may impact the use of ARARs on its unnamed tributaries.

6.1.3.3 Sediment/Soil TBC Criteria

Reviewing Table 4-1, it is observed that only BaP exceeded its guidance SSL in two of three sediment sample locations. However, it should be recognized that the SSL for BaP is significantly lower than the method detection limit. No exceedances were determined in Phase I sampling. In Phase II sampling, SD-1 resulted in elevated results in August 1997, and SD-2 resulted in elevated results in May 1997 but not in August 1997. Soil samples did not exceed guidance criteria in either Phase I or Phase II sampling.

The guidance SSLs used are calculated risk-based and site specific values for contaminants in soil/sediment that may be used to identify areas needing further investigation. EPA's Region III RBC Tables have SSLs listed, but they have been superseded by the EPA's Soil Screening Guidance (1995). The Soil Screening Guidance addresses chronic exposure to non-carcinogens and carcinogens through ingestion of soil in a residential setting. The approach for calculating the SSLs leads to levels that are about 3 times more conservative than preliminary remediation goals presented in EPA's Risk Assessment Guidance for Superfund (RAGS), Part B. Contaminant specific data along with the equations provided in the Soil Screening Guidance were used to calculate the site-specific SSLs.

6.2 Toxicity Assessment

TCE, RDX, Cd, 1,1,2,2-PCA, and BaP are the COC found in sampling results exceeding their respective ARARs and TBC criteria and found to have complete exposure pathways which could have an impact upon human health. Toxicity information on these chemicals follows.

6.2.1 Trichloroethene (TCE)

TCE is an industrial chemical that is considered a potential human carcinogen by the National Institute of Occupational Safety and Health (NIOSH), whereas the International Agency for Research on Cancer (IARC) has determined that TCE is not classifiable as to its carcinogenicity to humans. With chronic exposure, TCE can result in peripheral nerve degeneration, injury to the kidney and liver, and injury to the cardiovascular and gastrointestinal systems. In animal studies, TCE has produced cancers of the liver and lungs by means of oral administration. Routes of exposure are inhalation, ingestion and dermal contact.

According to the U.S. Public Health Service's Agency for Toxic Substances and Disease Registry (ATSDR), TCE evaporates to air quickly from surface water and soil. It does not stick to soil particles and moves quickly through the soil to groundwater. This indicates that TCE should not be readily taken up by the root systems of nearby vegetation which could be a food source for animal life. Also, according to ATSDR, fish do not store TCE in their bodies.

6.2.1.1 TCE Contamination at Site

TCE has been found in GW and SW during Phase I and II investigations of this RI in the Building 500 Area. The highest GW result for TCE at the investigation area was detected at MW C-7 during Phase II (1997) at 270 μg/l. MW C-7 is located upgradient of Building 500 on Site W property that was previously occupied by the Naval Surface Warfare Center. The highest SW result for TCE at the investigation area was detected at SW-3 during Phase II at 210 μg/l. SW-3 is also located on Site W property at the Site W swale, where GW discharges to the surface. SW-3 is downgradient from MW C-8 where 110 μg/l of TCE was detected.

6.2.1.2 TCE Carcinogenic Risk in Groundwater

The lifetime average daily exposure (LADE) is calculated below using the highest detection during the remedial investigation. Using the highest detections, worst-case scenario risks are calculated. The potential for off-site migration of the contaminant plume is the reason that the highest detection of TCE is used. By calculating the LADE, it can be used in conjunction with appropriate risk values to determine the potential cancer risk posed by the GW. Residential wells [redacted] of the Building 500 Area have future potential of being exposed to this contaminated groundwater.

$$LADE = \frac{C \times IR \times ED \times EF}{BW \times AT}$$

where,

C	=	concentration of COC	will use the highest concentration result at the site, 270 μg/l or 0.27 mg/l at MW C-7 in 1997
IR	=	intake/contact rate	oral intake is only considered with an assumed 2 liters per day of water intake per person
ED	=	exposure duration	off-site residents based on possible length of residency of 30 years
EF	=	exposure frequency	off-site residents based on all year exposure minus two weeks of vacation, 365 days - 15 days = 350 days/year
BW	=	adult body weight	assume 70 kg
AT	=	averaging time	70 years for carcinogenic risk or 25,550 days

$$LADE_O = \frac{(0.27)(2)(30)(350)}{(70)(25,550)} = 0.00317 \text{ or } 3.17 \times 10^{-3} \text{ mg/kg-day}$$

The calculation results in an LADE for ingestion ($LADE_O$) of TCE in GW in the vicinity of the Building 500 Area of 3.17×10^{-3} mg/kg-day for nearby adult residents.

By multiplying the cancer potency slope for oral intake (CPS_O) for TCE found in the RBC Table (1.10×10^{-2} kg-day/mg) by the $LADE_O$, the excess oral cancer risk for TCE to off-site residents using the GW for drinking water can be determined (see Sec. 3-14 of USACE EM 200-1-4).

$$\textbf{GW Ingestion Cancer Risk} = (CPS_O)(LADE_O) = (1.10 \times 10^{-2})(3.17 \times 10^{-3}) = \mathbf{3.49 \times 10^{-5}}$$

The above calculated risk is a worst-case scenario with the highest detection in GW used for analysis. The mean value of GW detections equal to or exceeding the TCE MCL was 60.9 µg/l. The mean value is more than four times less than the highest detection of TCE. If the mean value had been utilized in the calculation, the cancer risk would decrease:

$$LADE_O = \frac{(0.061)(2)(30)(350)}{(70)(25{,}550)} = 7.16 \times 10^{-4} \text{ mg/kg-day}$$

$$\textbf{GW Ingestion Cancer Risk} = (CPS_O)(LADE_O) = (1.10 \times 10^{-2})(7.16 \times 10^{-4}) = \mathbf{7.88 \times 10^{-6}}$$

If a nearby resident child's intake is considered then the resultant highest detection $LADE_O$ would decrease to 1.39×10^{-3} mg/kg-day with a reduced cancer risk to the child of 1.53×10^{-5} by means of the following calculations:

$$LADE_O = \frac{(0.27)(1)(6)(350)}{(16)(25{,}550)} = 1.39 \times 10^{-3} \text{ mg/kg-day}$$

$$\textbf{GW Ingestion Cancer Risk} = (CPS_O)(LADE_O) = (1.10 \times 10^{-2})(1.48 \times 10^{-3}) = \mathbf{1.53 \times 10^{-5}}$$

where,

- the IR changes to 1 liter/day,
- the ED changes to 6 years,
- the BW changes to 16 kg (as shown in Exhibit 6-14 of EPA RAGS, Part A, 1989), and
- the other exposure factors remain the same.

Because of assumed showering by off-site residents using GW, the potential intake of TCE by means of inhalation was also calculated:

$$LADE_i = \frac{C \times IR \times ET \times CF \times K \times ED \times EF}{BW \times AT}$$

where,

- the IR (Intake/contact Rate) changes to 0.6 m^3/hour as an inhalation intake rate,
- the K (volatilization factor) is added as 0.0005 x 1000 l/m^3 (0.5 l/m^3) for volatilizing TCE to air,
- *the ET (Exposure Time) is added as 12 mins/day,*
- the CF (Conversion Factor) is added as 1 hour/60 mins (0.0167 hour/min), and
- the other exposure factors remain the same.

Note: The above algorithm with IR and K values is used as specified in EPA RAGS, Part B. Specifically, Exhibit 6-16 of RAGS, Part A provides 0.6 m^3/hour for showering (all age groups, EPA 1989).

$$LADE_i = \frac{(0.27)(0.6)(12)(0.0167)(0.5)(30)(350)}{(70)(25{,}550)} = 9.53 \times 10^{-5} \text{ mg/kg-day}$$

The calculation results in a potential future worst-case $LADE_i$ for inhalation of TCE in GW in the vicinity of the Building 500 Area of 9.53 x 10^{-5} mg/kg-day for nearby residents.

By multiplying the cancer potency slope for inhalation intake (CPS_i) for TCE found in the RBC Table (6.0 x 10^{-3} kg-day/mg) by the $LADE_i$, the excess inhalation cancer risk for TCE to off-site residents using the GW for showering can be determined.

$$\textbf{GW Inhalation Cancer Risk} = (CPS_i)(LADE_i) = (6.0 \times 10^{-3})(9.53 \times 10^{-5}) = \mathbf{5.72 \times 10^{-7}}$$

If a nearby resident child's intake is considered then the resultant highest detection $LADE_i$ would decrease to 8.34 x 10^{-5} mg/kg-day with a reduced cancer risk to the child of 5.00 x 10^{-7} by means of the following calculations:

$$LADE_i = \frac{(0.27)(0.6)(12)(0.0167)(0.5)(6)(350)}{(16)(25{,}550)} = 8.34 \times 10^{-5} \text{ mg/kg-day}$$

$$\textbf{GW Inhalation Cancer Risk} = (CPS_i)(LADE_i) = (6.0 \times 10^{-3})(8.34 \times 10^{-5}) = \mathbf{5.00 \times 10^{-7}}$$

where,

- the ED changes to 6 years,
- the BW changes to 16 kg, and
- the other exposure factors remain the same.

Because of assumed showering by off-site residents using GW, the potential chemical intake of TCE by means of dermal contact was also calculated:

$$LADE_d = \frac{C \text{ x } SA \text{ x } PC \text{ x } ET \text{ x } CF \text{ x } ED \text{ x } EF}{BW \text{ x } AT}$$

where,

- the SA (skin Surface Area available for contact) is 19,400 cm^2 for adults,
- the PC (TCE permeability constant) is 1.6 x 10^{-2} cm/hr,
- the ET (Exposure Time) is added as 12 minutes/day (0.2 hours/day),
- the CF (Conversion Factor) is 1 liter/1000 cm^3 or 0.001 l/cm^3, and
- the other exposure factors remain the same.

Note: The PC was used as specified in EPA Dermal Exposure Assessment: Principles and Applications (1992).

$$LADE_d = \frac{(0.27)(19400)(0.016)(0.2)(0.001)(30)(350)}{(70)(25{,}550)} = 9.84 \times 10^{-5} \text{ mg/kg-day}$$

The calculation results in a potential future, worst-case $LADE_d$ for dermal contact with TCE in GW in the vicinity of the Building 500 Area of 9.84 x 10^{-5} mg/kg-day for nearby residents.

By multiplying the cancer potency slope for oral intake (CPS_o) for TCE by the $LADE_d$, the excess dermal cancer risk for TCE to off-site residents using GW for showering can be determined. The CPS_o was chosen over the CPS_i because it is based on absorbed dose which is the primary exposure route with dermal contact of TCE.

$$\textbf{GW Dermal Cancer Risk} = (CPS_o)(LADE_d) = (1.10 \times 10^{-2})(9.84 \times 10^{-5}) = \mathbf{1.08 \times 10^{-6}}$$

If a nearby resident child's intake is considered then the resultant highest detection $LADE_d$ would decrease to 3.23×10^{-5} mg/kg-day with a cancer risk to the child of 3.55×10^{-7} by means of the following calculations:

$$LADE_d = \frac{(0.27)(7280)(0.016)(0.2)(0.001)(6)(350)}{(16)(25{,}550)} = 3.23 \times 10^{-5} \text{ mg/kg-day}$$

$$\textbf{GW Dermal Cancer Risk} = (CPS_o)(LADE_d) = (1.10 \times 10^{-2})(3.45 \times 10^{-5}) = \mathbf{3.55 \times 10^{-7}}$$

where,

- the SA changes to 7,280 cm^2 for a 6 year old child,
- the ED changes to 6 years,
- the BW changes to 16 kg, and
- the other exposure factors remain the same.

6.2.1.3 TCE Carcinogenic Risk in Surface Water

With the data provided in Section 6.2.1.1, the LADE is calculated below so that the LADE can be used in conjunction with appropriate risk values to determine the potential cancer risk to humans posed by surface water dermal contact with tributary waters downgradient of the Building 500 Area to nearby residents, trespassers, and Building 500 workers:

$$LADE_d = \frac{C \times SA \times PC \times ET \times CF \times ED \times EF}{BW \times AT}$$

where,

- the C (Concentration of TCE in SW) is 0.21 mg/l,
- the SA (skin Surface Area available for contact) is 8,620 cm^2 for arms, hands and legs,
- the PC (TCE Permeability Constant) is 1.6×10^{-2} cm/hr,
- the ET (Exposure Time) is added as 0.3 hours/day,
- the CF (Conversion Factor) is 1 liter/1000 cm^3 or 0.001 l/cm^3, and
- the other exposure factors remain the same.

$$LADE_d = \frac{(0.21)(8620)(0.016)(0.3)(0.001)(30)(350)}{(70)(25{,}550)} = 5.10 \times 10^{-5} \text{ mg/kg-day}$$

The calculation results in a $LADE_d$ for dermal contact with TCE in SW in the vicinity of the Building 500 Area of 5.10×10^{-5} mg/kg-day for nearby residents.

Note - The off-site adult residents have been shown in the risk assessment to be the most sensitive potential receptor population for carcinogenic risk. It has been demonstrated that it is a population more sensitive than the off-site child resident. When compared to the other potential adult receptors, trespassers and Building 500 workers, the off-site residents remain as the most sensitive receptor population. The calculated SW $LADE_d$ for trespassers and Building 500 workers reduced to 3.04×10^{-5} mg/kg-day. For both populations, very conservative high end exposure parameters of 25 years for exposure duration (ED) and 250 days/year for exposure frequency (EF) were used in the algorithm with the remaining factors staying the same. Because the off-site adult resident remains the most sensitive population, the risk assessment will not address further the potential human receptors of trespassers and Building 500 workers.

By multiplying the cancer potency slope for oral intake (CPS_o) for TCE by the SW $LADE_d$ for nearby residents, the excess dermal cancer risk for TCE to potential receptors coming into contact with SW of nearby creeks can be determined. The CPS_o was chosen over the CPS_i because it is based on absorbed dose which is the primary exposure route with dermal contact of TCE.

$$\textbf{SW Dermal Cancer Risk} = (CPS_o)(LADE_d) = (1.10 \times 10^{-2})(5.10 \times 10^{-5}) = \mathbf{5.61 \times 10^{-7}}$$

If a nearby resident child's intake is considered then the resultant highest detection $LADE_d$ would decrease to 2.02×10^{-5} mg/kg-day with a reduced cancer risk to the child of 2.23×10^{-7} by means of the following calculations:

$$LADE_d = \frac{(0.21)(3910)(0.016)(0.3)(0.001)(6)(350)}{(16)(25{,}550)} = 2.02 \times 10^{-5} \text{ mg/kg-day}$$

$$\textbf{SW Dermal Cancer Risk} = (CPS_o)(LADE_d) = (1.10 \times 10^{-2})(2.02 \times 10^{-5}) = \mathbf{2.23 \times 10^{-7}}$$

6.2.1.4 TCE Non-Carcinogenic Hazard

For non-carcinogenic effects (NCE) of TCE, the relevant risk value is the RBC Table's Reference Dose (RfD) in mg/kg-day. The RfD is the estimate of the daily intake level (threshold value) that is expected to have no appreciable risk of adverse effects associated with it. The NCE LADE for TCE is recalculated from the algorithm used in Section 6.2.1.2 because the AT changes:

where,

- the AT (Averaging Time) changes to 30 years for non-carcinogenic hazard or 10,950 days, and
- the other exposure factors remain the same.

$$LADE_o = \frac{(0.27)(2)(30)(350)}{(70)(10{,}950)} = 7.40 \times 10^{-3} \text{ mg/kg-day}$$

The NCE $LADE_o$ calculated above is compared with the RfD oral exposure (RfD_o) for TCE (6.0×10^{-3} mg/kg-day). This comparison is called a hazard quotient (HQ) and is derived in the following manner.

$$\mathbf{HQ} = \frac{\text{NCE } LADE_o}{RfD_o} = \frac{7.40 \times 10^{-3}}{6.00 \times 10^{-3}} = \mathbf{1.23} \quad \mathbf{(>1)}$$

A summation of 1 is indicative of equaling unity or that the threshold level for potential occurrence of NCE is equaled. Summations greater than 1 indicate the estimated percentage above the established threshold level. The summation of 1.23 is essentially a calculated value 23% greater than the threshold established for that contaminant.

As discussed in Section 6.2.1.2 above, the mean value of GW detections exceeding the TCE MCL was 60.9 µg/l. The mean value is more than four times less than the highest detection of TCE. If the mean value had been utilized in the calculation, the NCE $LADE_O$ would decrease to 1.67×10^{-3}, and therefore the following:

$$\textbf{HQ} = \frac{\text{NCE } LADE_O}{RfD_O} = \frac{1.67 \times 10^{-3}}{6.00 \times 10^{-3}} = \mathbf{0.28} \quad \mathbf{(<1)}$$

If a nearby resident child's intake is considered then the resultant highest detection NCE $LADE_O$ would increase to 1.62×10^{-2} mg/kg-day with an increased HQ to the child of 2.70 (>1) by means of the following calculations:

$$LADE_O = \frac{(0.27)(1)(6)(350)}{(16)(2{,}190)} = 1.62 \times 10^{-2} \text{ mg/kg-day}$$

$$\textbf{HQ} = \frac{\text{NCE } LADE_O}{RfD_O} = \frac{1.62 \times 10^{-2}}{6.00 \times 10^{-3}} = \mathbf{2.70} \quad \mathbf{(>1)}$$

where,

- the AT (Averaging Time) changes to 6 years for non-carcinogenic hazard or 2,190 days.

If the mean value of detections equaling or exceeding the MCL (60.9 µg/l) is used to determine estimated intake and hazard to the resident child, the results lower to the following:

$$LADE_O = \frac{(0.061)(1)(6)(350)}{(16)(2{,}190)} = 3.66 \times 10^{-3} \text{ mg/kg-day}$$

$$\textbf{HQ} = \frac{\text{NCE } LADE_O}{RfD_O} = \frac{3.66 \times 10^{-3}}{6.00 \times 10^{-3}} = \mathbf{0.61} \quad \mathbf{(<1)}$$

The NCE $LADE_i$ for inhalation by means of showering with GW is recalculated in the same manner as above with the following results:

$$LADE_i = \frac{(0.27)(0.6)(12)(0.0167)(0.5)(30)(350)}{(70)(10{,}950)} = 2.22 \times 10^{-4} \text{ mg/kg-day}$$

There is not an NCE RBC Table RfD established for inhalation exposure of TCE, therefore an HQ will not be determined for TCE by means of an inhalation pathway. The NCE $LADE_i$ for a child is calculated in the following manner:

$$LADE_i = \frac{(0.27)(0.6)(12)(0.0167)(0.5)(6)(350)}{(16)(2{,}190)} = 9.73 \times 10^{-4} \text{ mg/kg-day}$$

The NCE $LADE_d$ for dermal contact to GW is recalculated in the same manner as above with the following results:

$$LADE_d = \frac{(0.27)(19400)(0.016)(0.2)(0.001)(30)(350)}{(70)(10{,}950)} = 2.30 \times 10^{-4} \text{ mg/kg-day}$$

$$\textbf{HQ} = \frac{\text{NCE LADE}_d}{\text{RfD}_o} = \frac{2.30 \times 10^{-4}}{6.00 \times 10^{-3}} = \textbf{0.038} \quad \textbf{(<1)}$$

If a nearby resident child's intake is considered then the resultant highest detection NCE $LADE_d$ would increase to 3.77×10^{-4} mg/kg-day with an increased HQ to the child of 0.063 (<1) by means of the following calculations:

$$\text{LADE}_d = \frac{(0.27)(7280)(0.016)(0.2)(0.001)(6)(350)}{(16)(2{,}190)} = 3.77 \times 10^{-4} \text{ mg/kg-day}$$

$$\textbf{HQ} = \frac{\text{NCE LADE}_d}{\text{RfD}_o} = \frac{3.77 \times 10^{-4}}{6.00 \times 10^{-3}} = \textbf{0.063} \quad \textbf{(<1)}$$

The NCE $LADE_d$ for dermal contact to SW is recalculated in the same manner as above with the following results:

$$\text{LADE}_d = \frac{(0.21)(8620)(0.016)(0.3)(0.001)(30)(350)}{(70)(10{,}950)} = 1.19 \times 10^{-4} \text{ mg/kg-day}$$

$$\textbf{HQ} = \frac{\text{NCE LADE}_d}{\text{RfD}_o} = \frac{1.19 \times 10^{-4}}{6.00 \times 10^{-3}} = \textbf{0.020} \quad \textbf{(<1)}$$

If a nearby resident child's intake is considered then the resultant highest detection NCE $LADE_d$ would increase to 2.36×10^{-4} mg/kg-day with a increased HQ to the child of 0.039 (<1) by means of the following calculations:

$$\text{LADE}_d = \frac{(0.21)(3910)(0.016)(0.3)(0.001)(6)(350)}{(16)(2{,}190)} = 2.36 \times 10^{-4} \text{ mg/kg-day}$$

$$\textbf{HQ} = \frac{\text{NCE LADE}_d}{\text{RfD}_o} = \frac{4.72 \times 10^{-5}}{6.00 \times 10^{-3}} = \textbf{0.039} \quad \textbf{(<1)}$$

The above risk and hazard estimates have been placed in a tabular form titled, Cumulative Summary Table for Site COC (Table 6-2). It is designed as an easy way to evaluate the COC by chemical intake, most sensitive potential populations, individual pathways and cumulative summation. The remaining COC are also included in the table.

6.2.2 1,1,2,2-Tetrachloroethane (1,1,2,2-PCA)

1,1,2,2-PCA, also known as perchloroethane, is an industrial chemical that is considered a potential human occupational carcinogen by NIOSH. However, the American Conference of Governmental Industrial Hygienists (ACGIH) list considers 1,1,2,2-PCA as not classifiable as a human carcinogen. With chronic exposure, 1,1,2,2-PCA can result in tremors in the fingers, jaundice, hepatitis and kidney damage. 1,1,2,2-PCA also can cause damage to the liver, central nervous system, gastrointestinal tract and the skin. In animal studies, 1,1,2,2-PCA has produced cancer of the liver. Routes of exposure are inhalation, ingestion, absorption, and dermal contact.

6.2.2.1 1,1,2,2-PCA Contamination at Site

1,1,2,2-PCA has been found in GW and SW during Phase I and II investigations of this RI in the Building 500 Area. The highest GW result for 1,1,2,2-PCA at the investigation area was detected at MW C-7 during Phase II (1997) at 11 µg/l. MW C-7 is located upgradient of Building 500 on Site W property that was previously occupied by the NSWC. The highest SW result for 1,1,2,2-PCA at the investigation area was detected at SW-3 during Phase II at 12 µg/l. SW-3 is also located on Site W property at the Site W swale where GW is believed to discharge to the surface. SW-3 is downgradient from MW C-8 where 5 µg/l of 1,1,2,2-PCA was detected.

6.2.2.2 1,1,2,2-PCA Carcinogenic Risk and Non-Carcinogenic Hazard

Utilizing algorithms discussed in Sections 6.2.1.2, 6.2.1.3 and 6.2.1.4 along with their standard exposure values, estimated chemical intake and risk/hazard estimates were determined for 1,1,2,2 PCA. Specific values for 1,1,2,2 PCA were used in the calculations in the following manner:

- the C is 0.011 mg/l in GW and 0.012 mg/l in SW,
- the CPS_o is 2.00×10^{-1} and CPS_i is 2.03×10^{-1},
- the PC is 9.0×10^{-3} cm/hr, and
- the RfD_o and RfD_i has not been determined.

See Table 6-2 for cumulative summary of 1,1,2,2-PCA estimated chemical intake and risk/hazard estimates. For an adult, the calculated cancer risks were 2.58×10^{-5} for GW ingestion, 7.88×10^{-7} for GW inhalation, 4.51×10^{-7} for GW dermal, and 3.28×10^{-7} for SW dermal. Because a RfD has not been determined by EPA for non-carcinogenic hazards of 1,1,2,2-PCA, the HQ could not be calculated. For a child, the calculated cancer risks were 1.13×10^{-5} for GW ingestion, 6.90×10^{-7} for GW inhalation, 1.48×10^{-7} for GW dermal, and 1.30×10^{-7} for SW dermal. Cumulatively, the overall cancer risk to an adult is 2.74×10^{-5} and the risk is 1.23×10^{-5} for a child.

6.2.3 Cadmium (Cd)

Cadmium is a natural element in the earth's crust. It is usually found combined with other elements in minerals. Typical soils and rocks, including mineral fertilizers, have some Cd in them. Cd does not corrode easily and is used in industry in the manufacturing of batteries, pigments, metal coatings, and plastics. Chronic exposure to Cd can result in a loss of smell, ulceration of the nose, emphysema, kidney damage and mild anemia. Cd has been reported to cause an increased incidence of cancer of the prostate in man. Routes of exposure are inhalation and ingestion.

According to ATSDR, Cd enters the air from industry, burning coal and household wastes. Cd enters water and soil from waste disposal, spills and leaks at hazardous waste sites. It binds strongly to soil particles, and some Cd dissolves in water. It does not break down in the environment but can change forms. Fish, plants and animals take up Cd from the environment. Cd stays in the body a very long time and can build up from many years of exposure to low levels.

6.2.3.1 Cd Contamination at Site

Cd has been found in GW during Phase I and II investigations of this RI in the Building 500 Area exceeding regulatory limits. The highest GW result for Cd at the investigation area was detected in MW A-2 during Phase II (1997) at 19 µg/l. This highest detection, however, was for total Cd metal and not dissolved Cd. Because of human consumption of GW, the more appropriate dissolved Cd result will be used in the risk assessment. The highest GW result for dissolved Cd was detected in MW A-2 during Phase II as well at 14 μg/l. MW A-2 is located less than 150 feet southwest of Building 500.

6.2.3.2 Cd Carcinogenic Risk and Non-Carcinogenic Hazard

Utilizing algorithms discussed in Sections 6.2.1.2, 6.2.1.3 and 6.2.1.4 along with their standard exposure values, estimated chemical intake and risk/hazard estimates were determined for Cd. Specific values for Cd were used in the calculations in the following manner:

- the C is 0.014 mg/l in GW and 0.011 mg/l in GW as a mean value of detections exceeding MCL, and
- the RfD_O is 5.00×10^{-4}.

See Table 6-2 for cumulative summary of Cd estimated chemical intake and risk/hazard estimates. Through a GW ingestion pathway, the HQ for an adult is 0.77 for the highest detection calculation and 0.60 when the mean value of detected concentrations ≥ MCLs is used. For a child, the HQ for the same pathway is 1.68 or 1.32 for mean value calculations.

The RBC Table does not list a CPS_O (cancer potency slope factor) for Cd when the exposure is through oral administration (water ingestion). This indicates that Cd does not pose a significant cancer risk through its ingestion. The RBC Table does list a CPS_i for Cd, which indicates that inhalation of Cd particulates presents a quantifiable cancer risk. With Cd being bound in a water-borne state (either dissolved or undissolved), the potential for Cd particulate inhalation exposure is minimal, and the carcinogenic risk of Cd in GW will not be considered further by the risk assessment. Also, the NCE RBC Table RfD established for inhalation exposure of Cd will not be used for the calculation of an inhalation HQ for the risk assessment.

6.2.4 Hexahydro-1,3,5-Trinitro-1,3,5-Triazine (RDX)

Also known as cyclonite, RDX is a white crystalline solid extensively used by the military as an explosive. It is used occasionally as a rodenticide. Exposure to RDX can occur through inhalation, ingestion, and eye or skin contact. Absorption through the skin apparently has not been demonstrated. It is slightly soluble in water and apolar organic solvents and readily soluble in polar organic solvents. In humans, RDX is slowly absorbed from the gastrointestinal tract after ingestion and from the lungs after inhalation. RDX is toxic to the central nervous system. Chronic exposure can cause seizures, skin sensitization, and irritability. Based on EPA guidelines, RDX was assigned to weight-of-evidence Group C (possible human carcinogen) based on increased liver tumors in mice. The estimated fatal dose of RDX in humans ranges from 5 to 500 mg/kg.

RDX can enter the environment through wastewater discharges from the manufacture and loading of RDX, and migration from settling ponds into soil. Subsequent leaching to GW would be expected. Direct photochemical degradation is the major removal process in translucent waters. Because of its solid state, it is not expected to have much mobility in the environment. It has a molecular weight greater than 200 and specific gravity of 1.82 which makes it heavier than water. It has a vapor pressure of 0.0004 mm Hg which indicates that volatilization is a minimal concern.

6.2.4.1 RDX Contamination at Site

RDX has been found in GW during Phase I and II investigations of this RI in the Building 500 Area exceeding TBC criteria guidance. The highest GW result for RDX at the investigation area was detected in MW C-5 during Phase I (1996) at 7.3 μg/l. RDX has also been found in SW exceeding TBC advisory guidance. The highest SW result for RDX at the investigation area was detected at SW-3 during Phase II (1997) at 2.2 μg/l. Because of the normal narrow nature of the unnamed creeks (about 2 feet across) and shallow depths (less than 1 foot), inadvertent water ingestion of the SW is not likely. The SW ingestion pathway is considered incomplete for RDX. Because of RDX's chemical and physical properties, SW dermal pathway is also considered incomplete. These pathways will not be considered further by the risk assessment.

6.2.4.2 RDX Carcinogenic Risk and Non-Carcinogenic Hazard

Utilizing algorithms discussed in Sections 6.2.1.2 along with their standard exposure values, estimated chemical intake and risk/hazard estimates were determined for RDX. Specific values for RDX were used in the calculations in the following manner:

- the C is 0.007 mg/l in GW, and
- the RfD_O is 3.00×10^{-3} and CPS_O is 1.1×10^{-1}.

See Table 6-2 for cumulative summary of RDX estimated chemical intake and risk/hazard estimates. For the GW ingestion pathway, the cancer risk was calculated as 9.04×10^{-6} for an adult and 3.96×10^{-6} for a child. The HQ for the same pathway was 0.064 for an adult and 0.14 for a child.

6.2.5 Benzo(a)pyrene (BaP)

Benzo(a)pyrene is a specific chemical of the group of compounds known as polynuclear aromatic hydrocarbons (PAHs). As a group, they are mainly solid chemicals that are soluble in fats, oils and organic solvents. As such, they are normally associated with industrial oils, greases and lubricants. They are found in cigarette smoke, exhaust gases of diesel engines, and in peat deposit areas. PAHs are also emitted through energy production. PAHs associated with coal tar pitch volatiles, such as BaP, are associated with an increased risk of developing bronchitis and cancer of the lungs, skin, bladder and kidneys. Chronic exposure may cause sunlight to have more severe effects on the skin with potential allergic skin rash developing. Routes of exposure are inhalation and dermal.

According to ATSDR, most PAHs do not dissolve easily in water, but some PAHs readily evaporate into the air. PAHs generally do not burn easily and they will last in the environment for months to years. PAHs have been found in some drinking water supplies in the United States. The background level of PAHs in drinking water ranges from 4 to 24 nanograms per liter. PAHs are not very mobile in soil and do not break down readily in the environment. For BaP, physical constants for the chemical indicate that the chemical could absorb in soil, run off with soil, and be bioaccumulated. Volatility of BaP should be of no concern.

6.2.5.1 BaP Contamination at Site

BaP has been detected in sediment samples taken during Phase II investigations in 1997. The elevated detections were realized at the two unnamed creeks south of and off-site from the Building 500 Area. Sample locations SD-1 and SD-2 detected elevated levels of BaP with SD-1 recording the highest level, 1.0 mg/kg.

6.2.5.2 BaP Carcinogenic Risk and Non-Carcinogenic Hazard

Because BaP was detected in sediments, algorithms not previously used in the risk assessment will be used to evaluate BaP. The following algorithms along with the parameters and assumptions used in assessing potential exposures to BaP are presented below.

For calculating human exposure to sediment where ingestion may occur, the following is presented and was referenced from Exhibit 6-14 RAGS, Part A:

$$LADE_{ing} = \frac{C \times IR \times CF \times FI \times ED \times EF}{BW \times AT}$$

where,

- the C is 1.0 mg/kg,
- the IR is an ingestion rate assumed at 100 mg/day for adults and 200 mg/kg for a child,
- the CF is a conversion factor added as 10^{-6} kg/mg,
- the FI is fraction ingested assuming 100% of soil is contaminated, so 1.0 is used, and
- the other exposure factors remain the same as presented previously.

For calculating human exposure to sediment where dermal contact may occur, the following is presented and was referenced from Exhibit 6-15 RAGS, Part A:

$$LADE_{sd} = \frac{C \times SA \times CF \times AF \times ABS \times ED \times EF}{BW \times AT}$$

where,

- the SA is the same as presented in Section 6.2.1.3,
- the AF (adherence factor) is soil to skin adherence assumed as 1 mg/cm^2, and
- the ABS (absorption factor) for BaP/PAHs is 0.05.

See Table 6-2 for cumulative summary of BaP estimated chemical intake and risk/hazard estimates. For sediment, the cancer risk was calculated as 4.29×10^{-6} for an ingestion pathway and 1.85×10^{-5} for a dermal pathway for an adult. For a child in the same media, the risk was calculated as 7.52×10^{-6} for an ingestion pathway and 7.30×10^{-6} for a dermal pathway. EPA has not determined a RfD for BaP and therefore a HQ could not be calculated.

6.2.6 Overall Carcinogenic Risk

To estimate the total cancer risk associated with exposure to multiple carcinogens in a given exposure pathway, the individual cancer risks are assumed to be additive, such as the following:

$$Risk_1 + Risk_2 \ldots\ldots + Risk_n = \text{Total } Risk_p \text{ (total risk of the pathway)}$$

Inserting the calculated risk values for COC in GW, the total cancer risk for GW in the Building 500 Area can be calculated:

where,
- $Risk_1$ = TCE in GW ingestion risk of 3.49×10^{-5},
- $Risk_2$ = TCE in GW inhalation risk of 5.72×10^{-7},
- $Risk_3$ = TCE in GW dermal contact risk of 1.08×10^{-6},
- $Risk_4$ = 1,1,2,2-PCA in GW ingestion risk of 2.58×10^{-5},
- $Risk_5$ = 1,1,2,2-PCA in GW inhalation risk of 7.88×10^{-7},
- $Risk_6$ = 1,1,2,2-PCA in GW dermal contact risk of 4.51×10^{-7},
- $Risk_7$ = RDX in GW ingestion risk of 9.04×10^{-6},

Overall GW Cancer Risk = 7.26×10^{-5} for adults and 3.23×10^{-5} for a child

To estimate the total cancer risk associated with exposure to multiple carcinogens in multiple exposure pathways, the individual cancer risks are assumed to be additive, such as stated above. With potential additional cancer risks from TCE and 1,1,2,2-PCA in surface water, the above formula is used again:

where,
- $Risk_8$ = TCE in SW as a dermal risk of 5.61×10^{-7},
- $Risk_9$ = 1,1,2,2-PCA in SW as a dermal risk of 3.28×10^{-7},
- $Risk_{10}$ = BaP in Sediment as an ingestion risk of 4.29×10^{-6},
- $Risk_{11}$ = BaP in Sediment as a dermal risk of 1.85×10^{-5}, and
- the other Risk values remain the same.

Overall Cancer Risk = 9.63×10^{-5} for adults and 4.74×10^{-5} for a child

The calculated overall total cancer risk from the remedial investigation at the Building 500 Area from multiple carcinogens and multiple exposure pathways is 9.63×10^{-5} for the most sensitive population.

6.2.7 Overall Non-Carcinogenic Hazard

To estimate the non-carcinogenic hazard associated with exposure to multiple COC with potential non-carcinogenic effects in multiple exposure pathways, the individual Hazard Quotients (HQ) for the COC are assumed to be additive, such as the following:

$$HQ_1 + HQ_2 \ldots\ldots + HQ_n = \text{Total } HQ_s \text{ (total hazard quotient of the site area)}$$

Inserting the calculated HQs for COC at the site in GW and SW, the total non-carcinogenic hazard for the most sensitive population (child) of the Building 500 Area can be calculated:

where,
- HQ_1 = TCE in GW ingestion hazard of 2.70,
- HQ_2 = TCE in GW dermal hazard of 0.063
- HQ_3 = TCE in SW dermal hazard of 0.039,
- HQ_4 = Cd in GW ingestion hazard of 1.68, and
- HQ_5 = RDX in GW ingestion hazard of 0.14,

Overall HQ for non-carcinogenic effects = 4.62 (>1) for children

The HQ of 4.62 is above the overall threshold limit established for non-carcinogenic effects of the COC at the investigation area. This HQ was based on a highest detections, worst-case scenario. If the mean values of detections equal to or exceeding regulatory MCLs (which is still a conservative approach) are used for TCE's GW ingestion pathway and Cd's GW ingestion pathway only, the overall HQ reduces to 2.17. Sections 6.2.1.4 and 6.2.3.2 also present calculations of HQ for TCE and Cd, respectively, using mean value data:

where,
- HQ_1 = TCE in GW ingestion hazard of 0.61,
- HQ_4 = Cd in GW ingestion hazard of 1.32, and
- the remaining values stay the same.

Overall Hazard Quotient for Non-Carcinogenic Effects = 2.17 (>1) for children

For an adult's exposure, the overall HQ for non-carcinogenic effects is 2.12 (>1). Utilizing the mean value data for TCE and Cd GW ingestion pathways, the HQ reduces to unity.

6.3 Risk Characterization

For the COC detected exceeding regulatory limits or recognized guidance during the RI at the Building 500 Area, the carcinogenic risks are in the acceptable cancer risk range as recognized by the EPA where complete exposure pathways were recognized. Inorganic Pb was eliminated as a COC as a management decision based on the location of its detection in a residential setting only. BEHP was also eliminated as a COC based on convincing data that sample contamination occurred by means of in-the-field or laboratory efforts. For COC Cd and RDX, their chemical and physical properties or insignificant potential exposures eliminated their dermal and inhalation exposure pathways for further consideration in the risk assessment.

6.3.1 Carcinogenic Characterization

Exposure pathways for TCE, 1,1,2,2-PCA, RDX, and Cd in GW; TCE and 1,1,2,2-PCA in SW; and BaP in sediment were considered complete for potentially exposing recognized receptors of nearby residents for GW, nearby residents, trespassers and Building 500 workers for SW, and nearby residents and trespassers for sediment. Carcinogenic risks and non-carcinogenic hazards were calculated based on the most conservative and second most conservative scenarios possible for potential exposure. For each COC mentioned above, the highest single point concentration was used to determine risk as the most conservative scenario. That single point concentration was then used as if every identified receptor would be exposed to that level. This worst-case exposure scenario was also considered for potential future exposures and receptors. The second most conservative scenario was the use of the mean value of detections of COC that were equal to or exceeded regulatory limits or TBC criteria.

GW has the potential to be used as a drinking water source by off-site residents near Building 500. The two nearest residential wells [redacted] and [redacted] were sampled during Phase I and II. Neither well detected TCE, 1,1,2,2-PCA, RDX or Cd in the two rounds of samples of the RI. Even though the contaminants in GW at levels exceeding regulatory/guidance limits were more than 400 feet upgradient of the nearest off-site residential well, drinking water ingestion, inhalation, and dermal contact cancer risks were calculated as if the highest single point concentrations of COC in specific media were detected or could be detected in the future in the residential wells.

The calculated cancer risks for ingestion of GW at a residence in a future worst-case scenario were higher than the calculated cancer risks for dermal contact and inhalation of GW at a residence for TCE and 1,1,2,2-PCA. Dermal and inhalation pathways for RDX were considered insignificant. The 1,1,2,2-PCA ingestion risk was calculated as 2.58×10^{-5}, the TCE calculated ingestion risk at 3.49×10^{-5}, and the RDX ingestion risk was calculated as 9.04×10^{-6}. These values are equivalent to estimated cancer risks of about 3 (2.58) excess cases/100,000 people, 3.5 (3.49) excess cases/100,000 people, and 9 (9.04) excess cases/1,000,000, respectively. These values are within EPA policy guidance of 10^{-4} (1 case/10,000) to 10^{-6} (1 case/1,000,000). The EPA guidance addresses excess cancer cases above the U.S. background of approximately 250,000 cancers per one million people.

The cancer risks for dermal contact to SW were less than the ingestion of GW risks. Inadvertent ingestion of SW was not considered a viable pathway in the area because of the shallowness of the nearby unnamed creeks. The calculated cancer risks for ingestion and dermal contact with BaP in sediments for a worst case scenario were also within the EPA policy guidance range, 4.29×10^{-6} and 1.85×10^{-5}, respectively.

For additive effects, the potential combined ingestion, inhalation, and dermal cancer risk of 1,1,2,2-PCA, RDX, TCE and BaP through exposure pathways of GW, SW, and sediment resulted in 9.63×10^{-5} or 10 cases/100,000 people. The calculated total overall cancer risk also is within EPA's guidance range. EPA guidance of 10^{-4} to 10^{-6} establishes a range of uncertainty regarding cancer risk with 10^{-6} as a point of departure where remediation goals are first considered. It is recognized that cancer risk estimates for a site are upper-bound estimates of potential risk and, as such, are conservative values. The actual cancer risk posed to exposed individuals is likely to be less and may approach zero. Using the highest single point concentrations as calculation values for the risk assessment, the ultra-conservative approach has obviously and deliberately overestimated the potential real-life cancer risks of the site area. And in doing so, calculation risks have remained within EPA's guidance range.

EPA does not consider Cd to present a carcinogenic hazard by the route of ingestion. With Cd being an inorganic particulate, it does not present itself as a significant inhalation hazard in GW. TCE and 1,1,2,2-PCA estimated cancer risks for dermal contact with SW and GW were calculated in the 10^{-7} range for both chemicals.

The above cancer risks were calculated based on adult chemical intake. When exposure factors used for calculating a child's chemical intake were used, the results were always less than the adult's chemical intake for each pathway of inhalation, ingestion, dermal contact, GW and SW. In determining cancer risks, the adult resident population is assumed to be the most sensitive population and the calculations bear this out.

6.3.2 Non-Carcinogenic Characterization

For non-carcinogenic effects, the resident child is assumed to be the most sensitive population and the risk assessment calculations bears this out as well. For a child, the non-carcinogenic hazard associated with TCE through a GW ingestion pathway was calculated as approximately 2.7 times greater than its threshold chemical intake that is recognized as unlikely to result in adverse non-carcinogenic health effects, which is stated as the RfD. The non-carcinogenic hazard associated with Cd through a GW ingestion pathway was calculated as approximately 1.68 times greater than its RfD. The additive non-carcinogenic hazard of these pathways alone was calculated as 4.38 times greater than the expected total hazard quotient exposure threshold for the two contaminants. The remaining pathway of ingestion for RDX and the dermal pathways for TCE add only 0.24 to the cumulative HQ for the site. EPA does not consider the non-carcinogenic hazards of 1,1,2,2-PCA and BaP, and EPA has not developed RfDs for the two contaminants.

As the risk assessment has attempted to use the most conservative values and assumptions, single point highest concentrations were used for the above calculations. The total hazard quotient for non-carcinogenic effects was recalculated using the mean values of the detections ≥ MCLs for TCE and Cd as a means of providing the next most conservative scenario. The recalculation resulted in a TCE hazard exposure potential of 61% (0.61) of its threshold chemical intake RfD and 1.32 times greater than Cd's RfD. The recalculated cumulative hazard for TCE, Cd, and the remaining pathways and COC (0.24) resulted in a cumulative hazard quotient 2.17 (0.61+1.32+0.24) times greater than the expected cumulative RfD.

A less conservative, although still acceptable, approach would have been to develop a 95% upper confidence limit level for all the samples taken of Cd in GW. That level (3.17 μg/l) would have resulted in a chemical intake estimate of 1.80×10^{-4} mg/kg-day, which would have resulted in a HQ reduction from 1.32 to 0.36 for Cd. If the same approach is applied to TCE and the other COC, it is recognized that a cumulative HQ for the COC would be less than unity (<1).

Obtaining a value of less than one for the most sensitive population to non-carcinogenic health effects was not the purpose of this risk assessment. The risk assessment has attempted to address the worst case potential scenarios for the COC identified in this RI and develop risks and hazards from that data. Utilizing this most conservative approach, two ingestion pathways (TCE and Cd in GW) exceeded unity for RfD comparisons out of a total of ten pathways. The second most conservative approach of using mean value data for selected COC produced only one ingestion pathway (Cd in GW) above unity out of ten pathway considerations.

6.4 Characterization of Uncertainty

Some uncertainty is inherent in the process of conducting a risk assessment. Environmental sampling and analysis, fate and transport modeling and human exposure pathways are all prone to uncertainty, as are the toxicity and exposure values used to characterize risk. For this risk assessment there is uncertainty regarding the sampling method detection limit for 1,1,2,2-PCA of 1.0 μg/l in GW with the guidance used for 1,1,2,2-PCA in GW at 0.052 μg/l. This could lead to an underestimation of the overall extent of GW contamination throughout the investigation area. This underestimation was addressed, however, because the highest detected level of the COC was used in risk calculations, which provided for very conservative risks.

There was also an uncertainty regarding the actual additive carcinogenic and non-carcinogenic effects of the COC in GW. The reality of the overestimation or underestimation is unknown. TCE, 1,1,2,2-PCA, and BaP are all classified as suspect carcinogens and as cumulative systemic toxins to the human body. RDX is classified as a suspect human carcinogen but is not recognized as a cumulative systemic toxin. Combining potential cancer risks as a result of exposure to multiple contaminants assumes that the contaminants will result in the same cancer effect and each contaminant exerts its effect independently. There is uncertainty whether TCE, 1,1,2,2-PCA, BaP, and RDX are antagonistic to each other (minimizing the collective effect of each) or synergistic to each other (increasing the hazard beyond their additive effects). If the uncertainty results in an underestimation, it is believed to be addressed, because the highest detected levels of the COC were used in risk calculations, which provided for very conservative evaluations of risks.

There is also uncertainty in the use of the RBC Table's carcinogenic CPS_O and non-carcinogenic RfD_O values for TCE. The August 1997 edition of the Table shows that TCE's CPS_O was withdrawn from IRIS or HEAST. Integrated Risk Information System (IRIS) and Health Effects Assessment Summary

Tables (HEAST) are EPA-based risk assessment databases. The withdrawal normally indicates that consensus on the value no longer exists among EPA scientists. TCE's RfD_O is classified as a provisional value by EPA's Superfund Health Risk Technical Support Center. Such a classification means that the value was set in response to a site-specific request from regional EPA risk assessors, and there is no assurance that the value is current. Utilizing the conservative approach with this risk assessment will probably increase the uncertainty. This indicates that the cancer risks due to TCE have been *overestimated and therefore are expected to be less than those calculated.*

The use of highest detected COC for risk calculations was an uncertainty that was believed to result in an overestimation of lifetime risks. This was justified because it brings about a very conservative characterization. Not considering the degradation or natural attenuation of COC was an uncertainty that probably overestimated the risks, because COC concentrations tend to decrease over time. The likelihood of exposure pathways through GW to off-site residents ingesting well water of COC detected in the Building 500 Area was an uncertainty that was probably overestimated because future pathways may not actually occur.

7.0 SUMMARY AND CONCLUSIONS

7.1 Summary

7.1.1 Significant Findings

Among the significant findings of this investigation are the following:

1) TCE was detected at two surface water locations and in seven groundwater monitoring wells above the MCL/AWQC of 5 µg/l;

2) 1,1,2,2-PCA was detected at concentrations above the EPA RBC of 0.052 µg/l at four monitoring wells;

3) the explosive compounds HMX and/or RDX were detected in three groundwater monitoring wells;

4) explosive compounds were also detected in two surface water sampling locations in the unnamed stream east of the [redacted] residence;

5) Cd was detected sporadically exceeding the MCL of 5 µg/l at three monitoring wells downgradient of Building 500;

6) chlorinated solvents have been found in sediment samples taken from streams on either side of the [redacted] residence, although all detections were below soil screening levels;

7) sediment samples taken from streams on either side of the [redacted] residence have shown isolated hits of benzo(a)pyrene above the SSL;

8) the oil/water separator, which is fed by the subdrainage system from Building 500, exhibited elevated concentrations of VOCs, BaP, Pb, Ni, and Cd.

Other sites investigated as part of this RI, including the surface stain near the Blowdown Area and the former UST locations, were not found to be sources of contamination. No COCs have been detected in off-site residential wells.

The spatial distribution of TCE, 1,1,2,2-PCA, and explosive compounds in the groundwater indicates that the source of the contamination is located upgradient of the Building 500 Area at the NSWC or on property that was formerly part of the NSWC. An RI conducted at the NSWC concluded that TCE was present in the groundwater at NSWC Site 9 (Malcolm Pirnie, 1992). Additionally, the NSWC has a documented history of contamination with nitroaromatic compounds that include HMX, RDX, 2,6-DNT and nitrobenzene (Malcolm Pirnie, 1992).

7.1.2 Groundwater Hydrology and Implications for Contaminant Transport

In general, the water table is a subdued reflection of the surface topography. Groundwater in the Building 500 Area has been observed in the Coastal Plain deposits and the bedrock Wissahickon Formation, with water levels in the bedrock 2-4 feet below those of the overlying Coastal Plain deposits. Although the Coastal Plain deposits and the bedrock Wissahickon Formation behave as a single interconnected water-bearing unit, the pathways may be tortuous.

The general groundwater flow direction is to the south towards Paint Branch Creek. Discharge areas in the Building 500 Area include unnamed streams east and west of the area, the Site W swale, a small stream to the west of the [redacted] residence, and Paint Branch Creek. All of the small, unnamed streams flow into Paint Branch Creek.

Flow paths constructed from potentiometric surface maps show that much of the groundwater in the area is funneled beneath Building 500 or towards streams on either side of the [redacted] residence. Groundwater flowing beneath Building 500 is intercepted by the subdrainage system and discharged from the oil/water separator effluent pipe, from whence it flows into the small stream west of the [redacted] residence.

Groundwater divides exist east and west of Building 500, and contaminants traveling from NSWC property might miss the Building 500 Area entirely and instead flow towards the unnamed stream south of Floral Drive and the unnamed stream west of the Building 500 Area.

Estimates of hydraulic conductivity for Coastal Plain deposits ranged from approximately 0.01 to 6.2 ft/day, whereas the bedrock wells yielded conductivities of 10^{-3} ft/day. Seepage velocities—representing advective transport in the Coastal Plain deposits—of up to 2.4 ft/day have been calculated. The limited slug test data from the bedrock monitoring wells and the specific capacity estimates of 0.02 to 0.04 gpm/ft from the [redacted] and [redacted] wells indicate that the hydraulic conductivity of the bedrock in this area is very low. There may be zones of higher conductivity, but, if so, they have not been encountered during this investigation.

Contaminant transport in bedrock is highly dependent on the quantity and interconnectedness of fractures. Despite head differences that indicate downward flow from the Coastal Plain deposits into the bedrock, the fractures necessary for good hydraulic communication are absent. Consequently, it is expected that movement of contaminants into the bedrock portion of the aquifer would be very limited. If contaminants were to enter bedrock fractures, data from the three bedrock wells suggest that off-site migration of those contaminants would occur at an exceedingly slow rate.

7.1.3 Risk Assessment

Based on the comparison of highest detected concentrations of contaminants in groundwater (GW), surface water (SW), sediment, and soil to ARARs and TBC criteria, the contaminants posing potential elevated carcinogenic risks and non-carcinogenic hazards to humans through the various exposure pathways are as follows: TCE, 1,1,2,2-PCA, RDX, and Cd in GW; TCE and 1,1,2,2-PCA in SW, and BaP in sediment. Inorganic Pb was eliminated as a COC as a management decision based on the location of its detection in a residential setting and presumed association with plumbing fixtures. BEHP was also eliminated as a COC based on convincing data that sample contamination had occurred by means of in-the-field or laboratory efforts. For COC Cd and RDX, their chemical and physical properties or insignificant potential exposures eliminated their dermal and inhalation exposure pathways for further consideration in the risk assessment.

Carcinogenic risks posed by RDX in GW and by TCE and 1,1,2,2-PCA in GW and SW—from ingestion, inhalation and dermal exposure—were in the 10^{-5} to 10^{-7} range. The overall additive carcinogenic risks from the above contaminants through individual and multiple exposure pathways were in the 10^{-5} range. Cd is not recognized as presenting a carcinogenic ingestion risk. Although there were elevated levels of Cd in GW, the inhalation exposure pathway for Cd was determined to be insignificant. Exposure to BaP in sediment, through ingestion and dermal pathways, posed a carcinogenic risk in the 10^{-5} to 10^{-6} range.

In considering the non-carcinogenic health effects of the COC at the site, the worst case potential scenarios were again applied. This most conservative approach—of using the highest detection of the COC for calculations and very conservative assumptions and default values—yielded two ingestion pathways (TCE and Cd in GW) that exceeded unity for RfD comparisons out of a total of ten pathways. The second most conservative approach of using mean value data for selected COC produced only one ingestion pathway remained above unity out of ten pathway considerations. The overall HQ for the most sensitive population (child) was 4.38 using the most conservative approach. Use of mean values resulted in an overall HQ of 2.17.

The risk assessment attempted to look at the most conservative scenarios for determining carcinogenic risks and non-carcinogenic hazards associated with contaminants detected in the site investigation area. It is believed that very conservative scenarios would compensate for the uncertainty issues that are inherent in risk assessments and provide an overestimation of the risk characterizations. Given that these most conservative risk determinations compare favorably with EPA's generally recognized acceptable cancer risk range (1×10^{-4} to 1×10^{-6}), the real-life potential exposure risks are expected to be much less and may approach zero.

7.2 Conclusions

7.2.1 Recommendations for Future Work

The results of the Building 500 Area remedial investigation show that contamination is present in the surface water and groundwater. Based on the findings of this investigation, the following actions are recommended:

1) Initiation of a Long-Term Monitoring (LTM) Program

The sampling and analytical approach will be extensively modified from the RI to emphasize tracking of compounds from contaminated wells to downgradient wells and surface water/sediment locations that are presently uncontaminated (Table 7-1). Wells A-1, A-2, and C-13, which are poorly suited to low-flow sampling techniques, will be dropped from the monitoring program.

The LTM Program will include:

a) Annual groundwater sampling of 10 of the 13 existing monitoring wells. Sampling will also include the [redacted] and [redacted] residential wells, until such time as they are connected to the public water system.

b) Annual surface water and sediment sampling at the Site W swale and [redacted] stream locations.

c) Annual water elevation gauging at all existing monitoring wells in the Building 500 Area.

2) Share Building 500 RI and LTM Data with NSWC

Given that the apparent source of contamination in the Building 500 Area is located on NSWC property, further investigations in the Building 500 Area should be coordinated with NSWC.

8.0 REFERENCES

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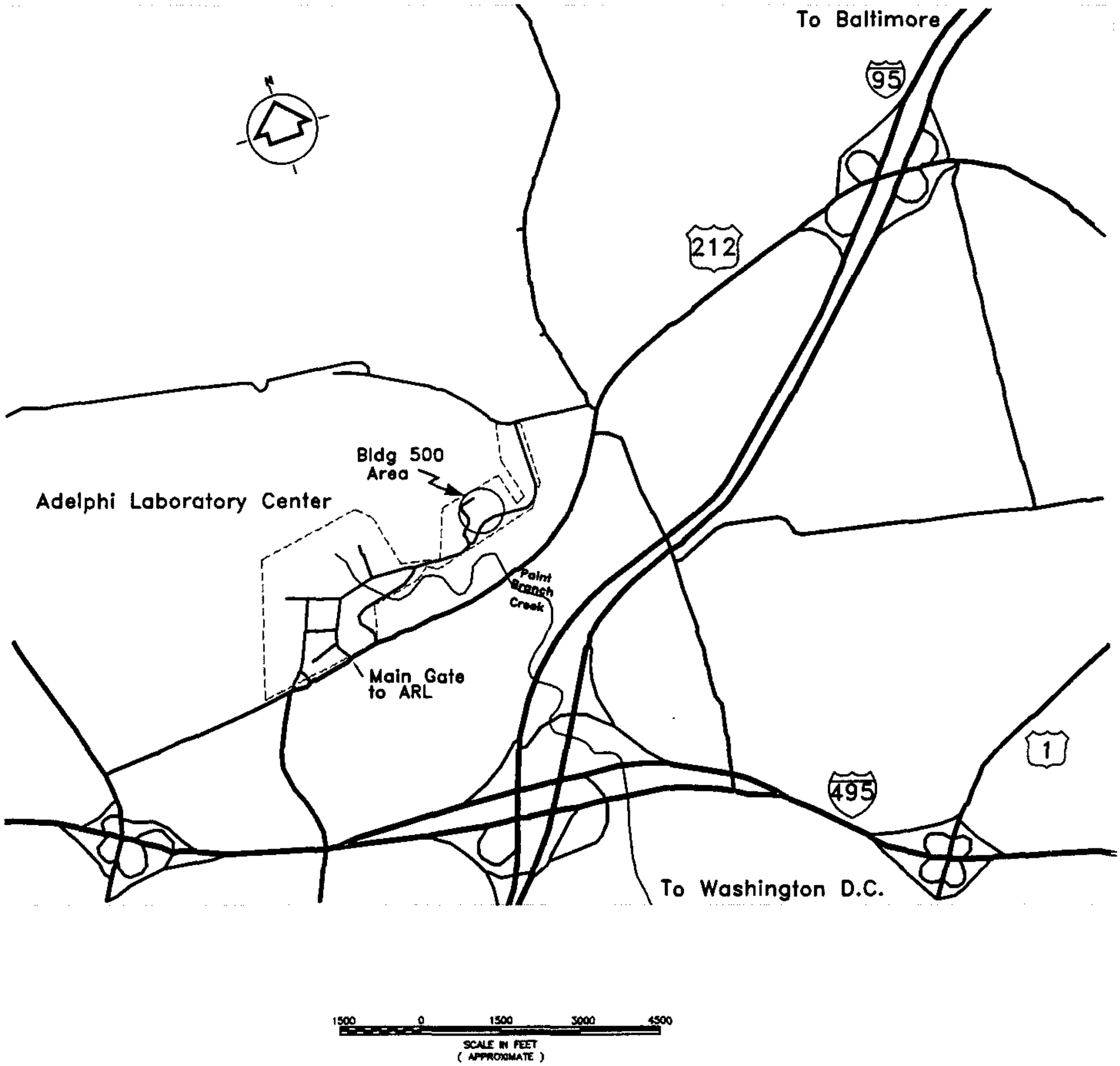
FIGURES



US Army Corps of Engineers

VICINITY MAP

ADELPHI LABORATORY CENTER
ADELPHI, MARYLAND
BDLG. 500 REMEDIAL INVESTIGATION

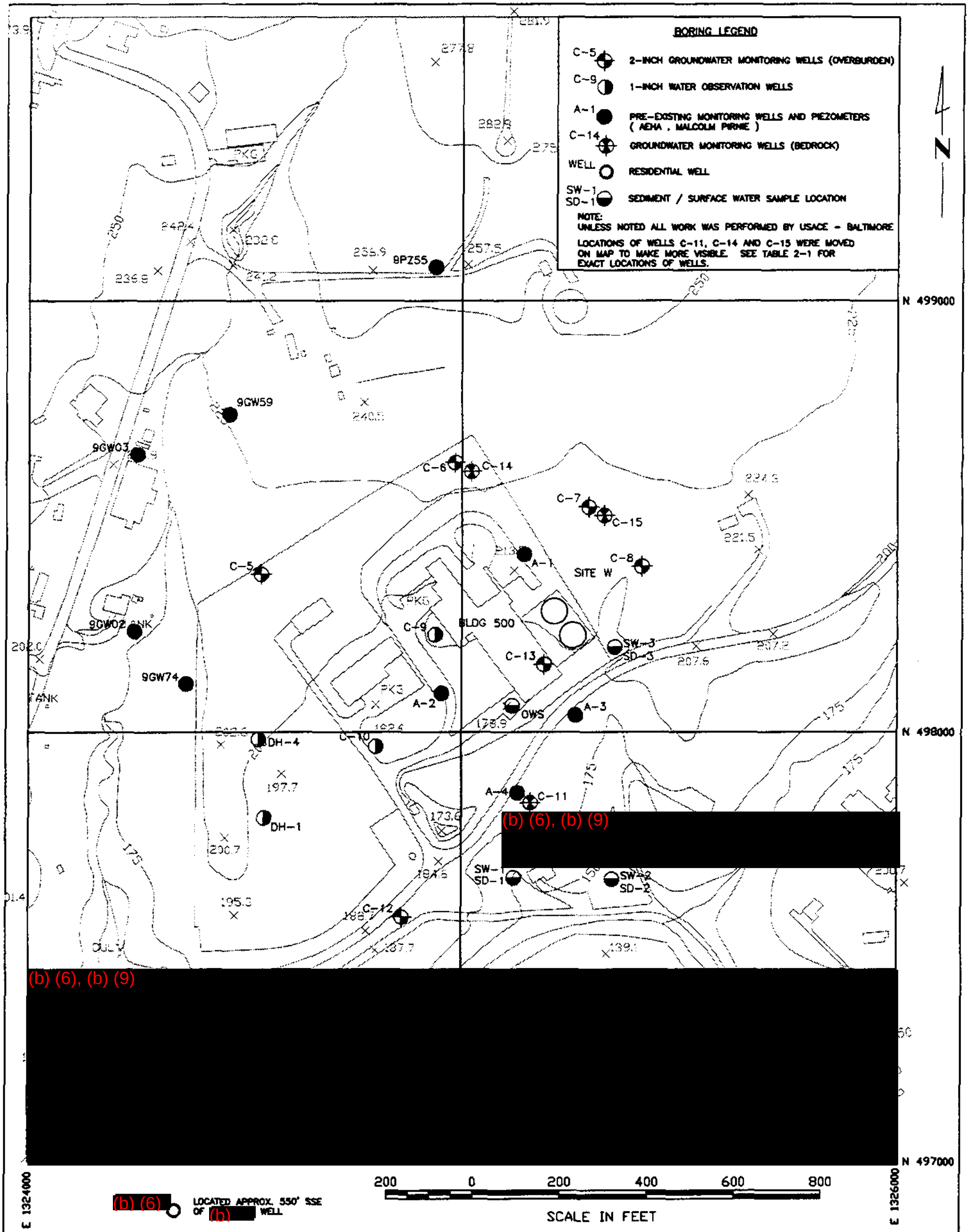
DATE: DEC 1997

SCALE: AS SHOWN

FIGURE 1-1

CADD

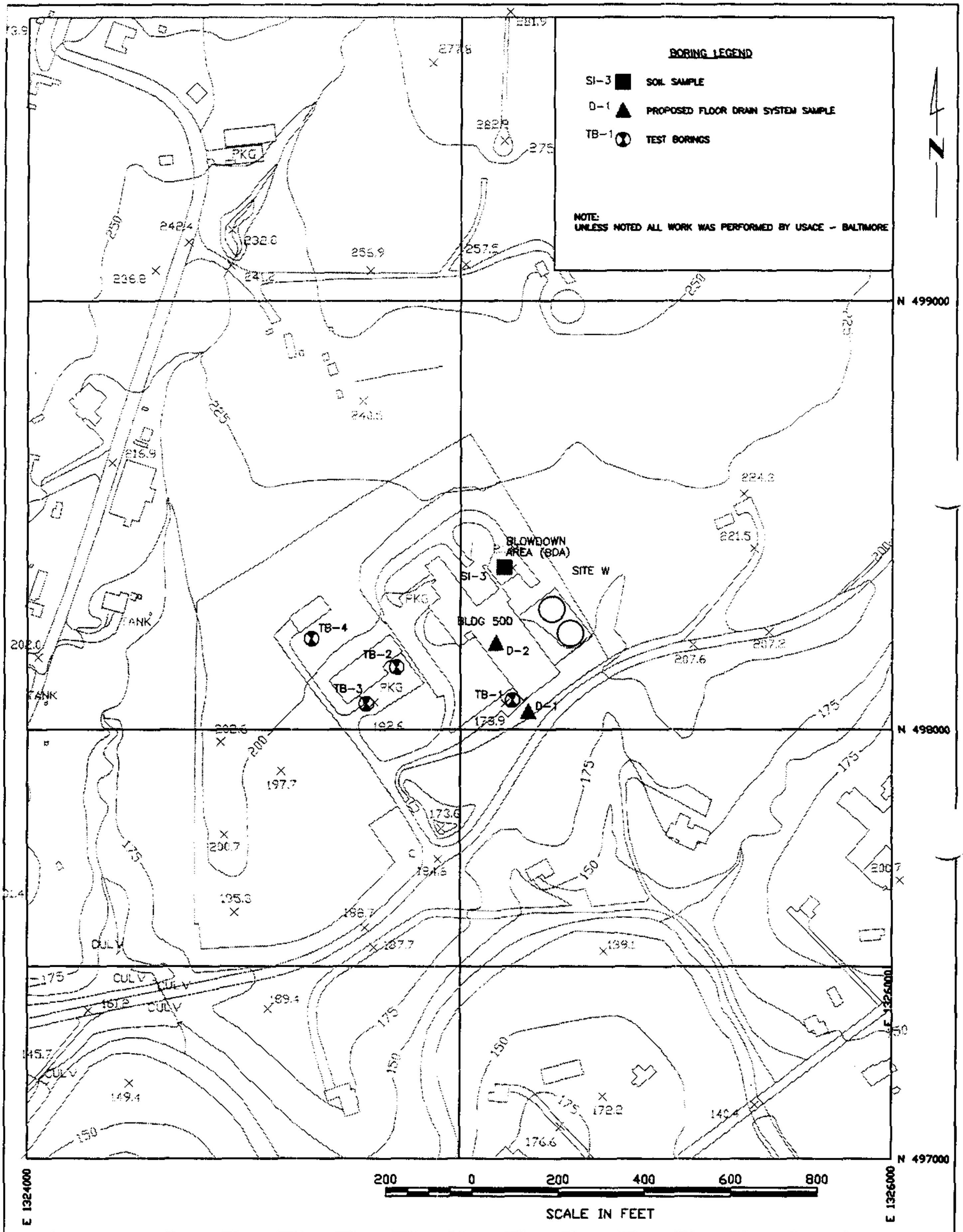
T:\HTRW\ARL-ADEL\B500-97\FIG_1-1.DWG



US Army Corps of Engineers Baltimore District

WATER/SEDIMENT SAMPLE LOCATION MAP ADELPHI LABORATORY CENTER ADELPHI, MARYLAND BLDG. 500 REMEDIAL INVESTIGATION	DATE: DEC 1997	SCALE: AS SHOWN
	(PHASE I AND II)	
		Fig 2-1

T:\HTRW\ARL-ADEL\B500-97\FIG_2-1.DWG



US Army Corps of Engineers Baltimore District

SOIL BORING LOCATION MAP
ADELPHI LABORATORY CENTER
ADELPHI, MARYLAND
BLDG. 500 REMEDIAL INVESTIGATION

DATE: AUG 1997 | SCALE: AS SHOWN

(PHASE I ONLY)

Fig 2-2

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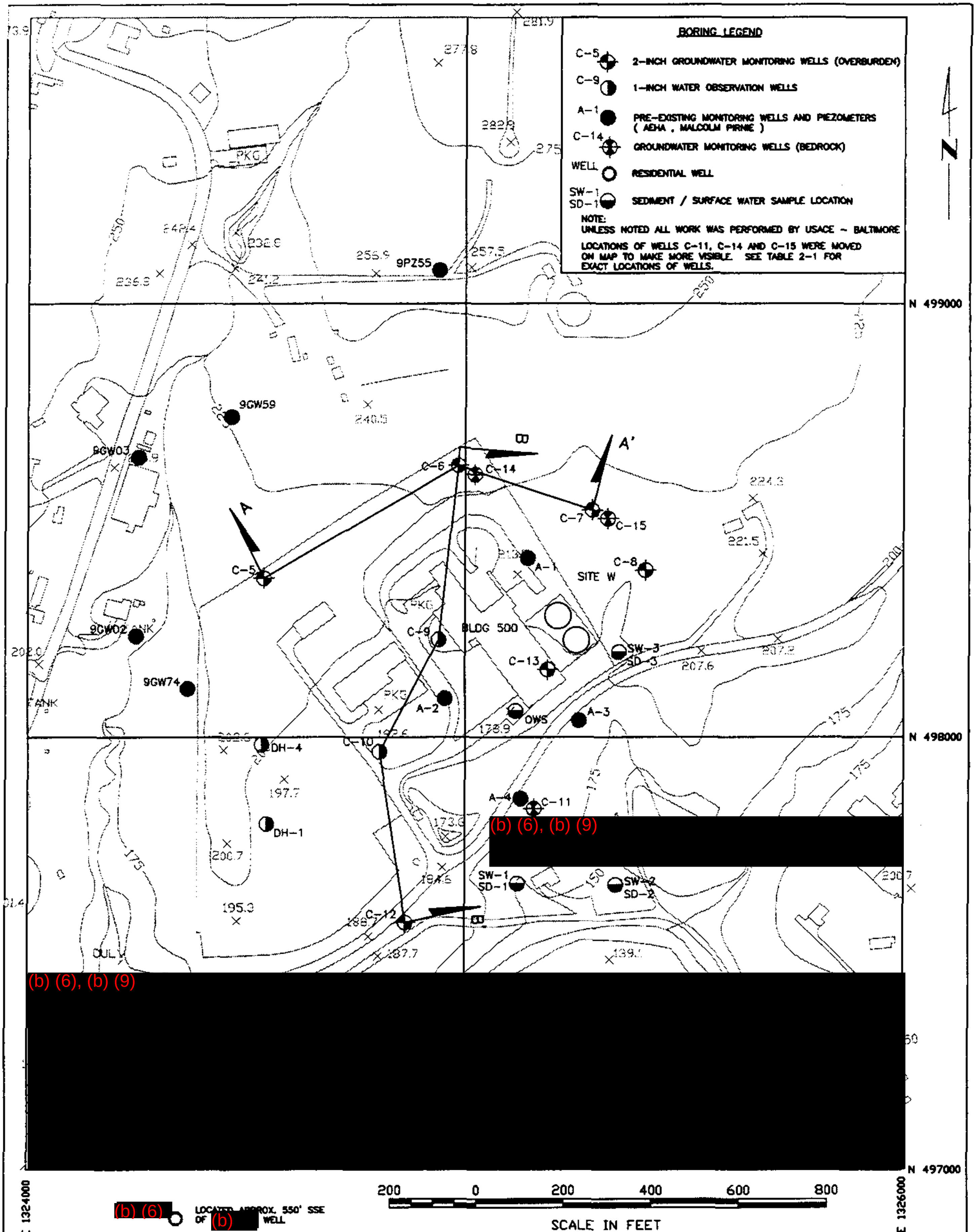


US Army Corps of Engineers Baltimore District

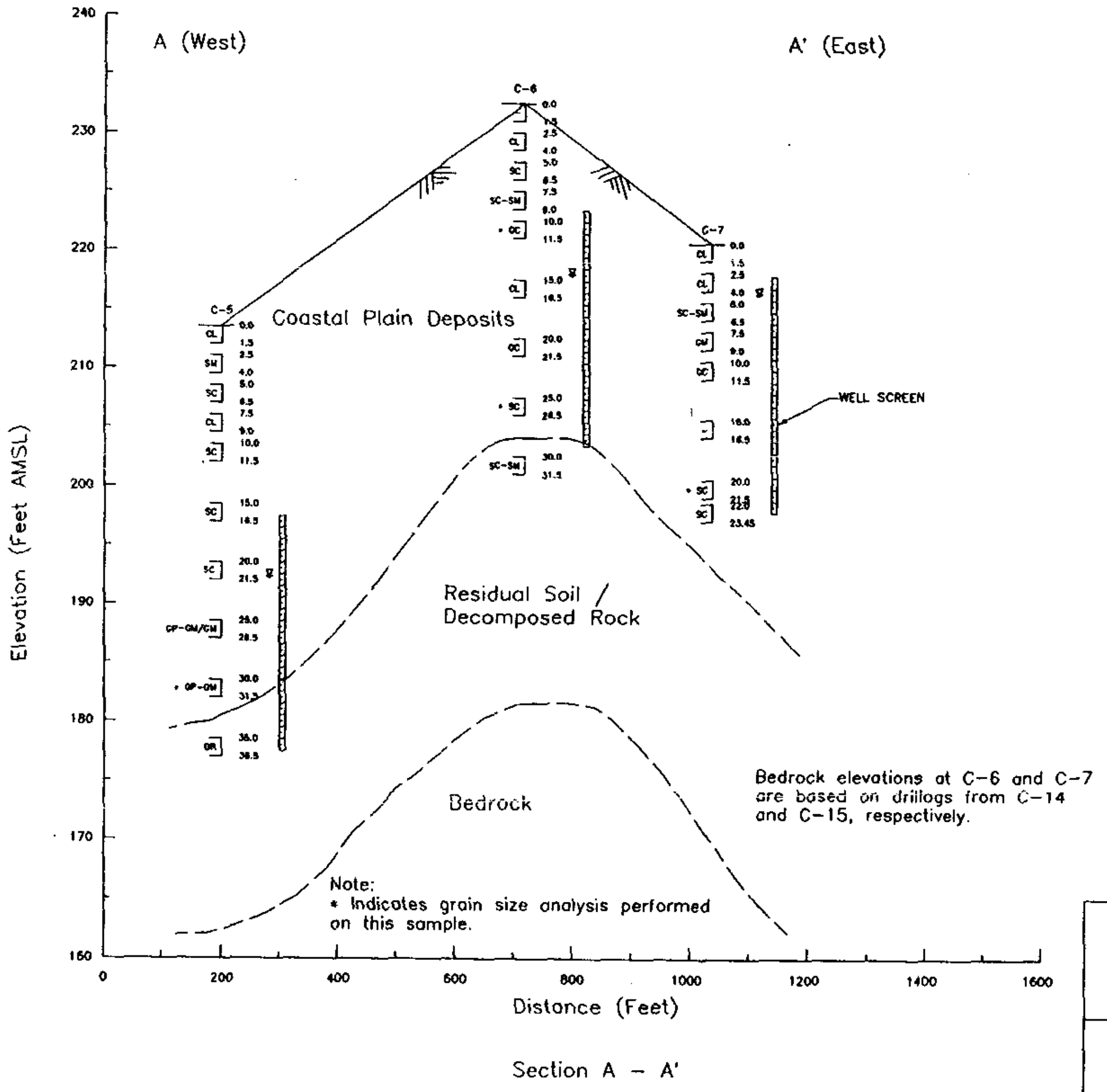
CROSS-SECTION PROFILE MAP
ADELPHI LABORATORY CENTER
ADELPHI, MARYLAND
BLDG. 500 REMEDIAL INVESTIGATION

DATE: AUG 1997

SCALE: AS SHOWN

Fig 3-1

T:\HTRW\ARL-ADEL\B500-97\FIG_3-1.DWG



UNIFIED SOIL CLASSIFICATION

GROUP SYMBOLS	TYPICAL DESCRIPTIONS
GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
SP	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
SM	SILTY SANDS, SAND - SILT MIXTURES
SC	CLAYEY SANDS, SAND - CLAY MIXTURES
ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
CH	INORGANIC CLAYS OF HIGH PLASTICITY
OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS
DR	DECOMPOSED ROCK

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

SCALE 5 0 5 10 VERTICAL

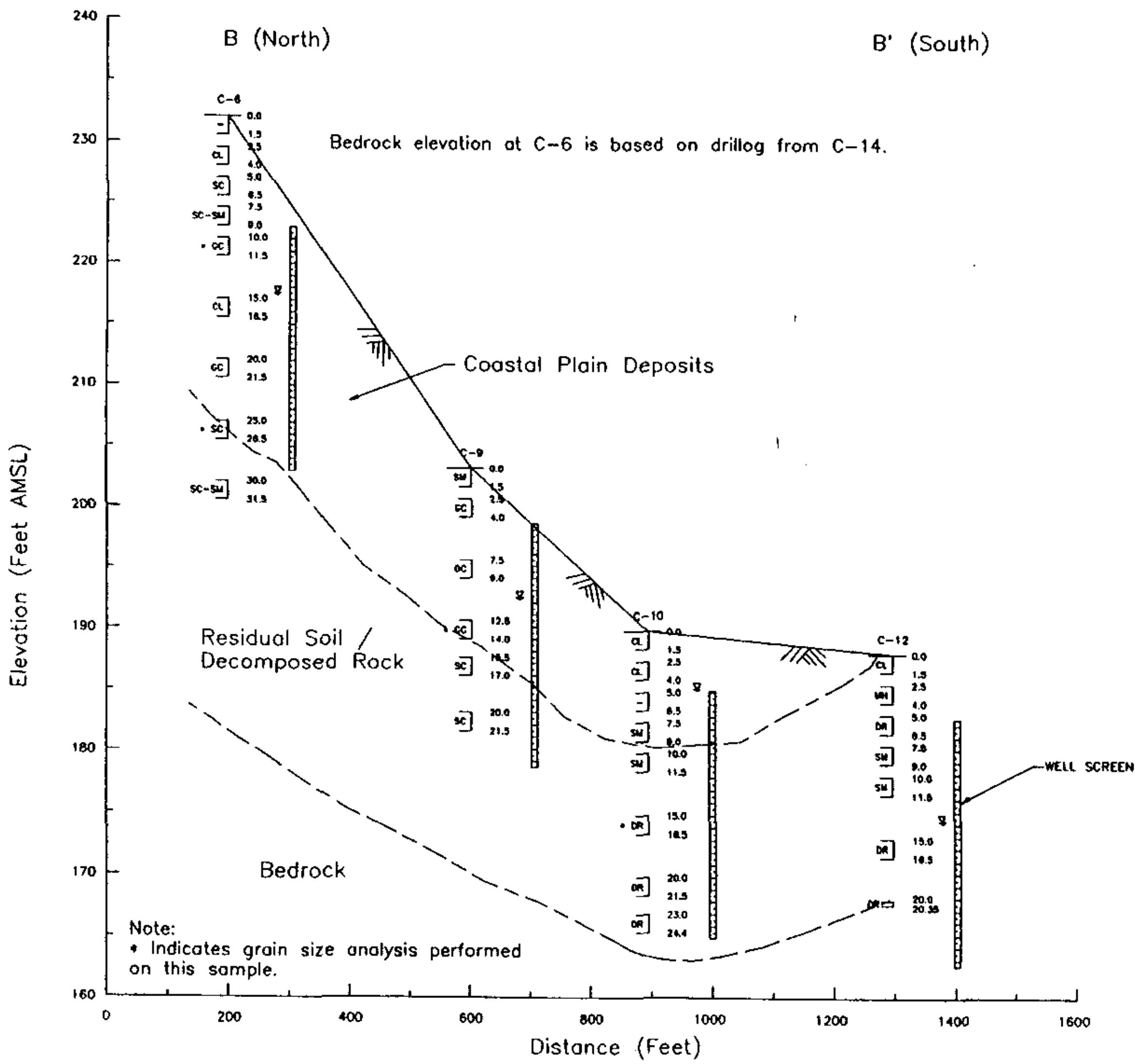
SCALE 100 0 100 200 HORIZONTAL

US Army Corps of Engineers

CROSS SECTION A–A'

ADELPHI LABORATORY CENTER
ADELPHI, MARYLAND
BLDG. 500 REMEDIAL INVESTIGATION

SCALE: AS SHOWN	DATE: AUG 1997	FIGURE 3-2

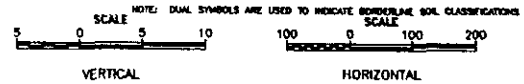


Section B – B'

UNIFIED SOIL CLASSIFICATION

GROUP SYMBOLS	TYPICAL DESCRIPTIONS
GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
SP	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
SM	SILTY SANDS, SAND - SILT MIXTURES
SC	CLAYEY SANDS, SAND - CLAY MIXTURES
ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
CH	INORGANIC CLAYS OF HIGH PLASTICITY
OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS
DR	DECOMPOSED ROCK

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

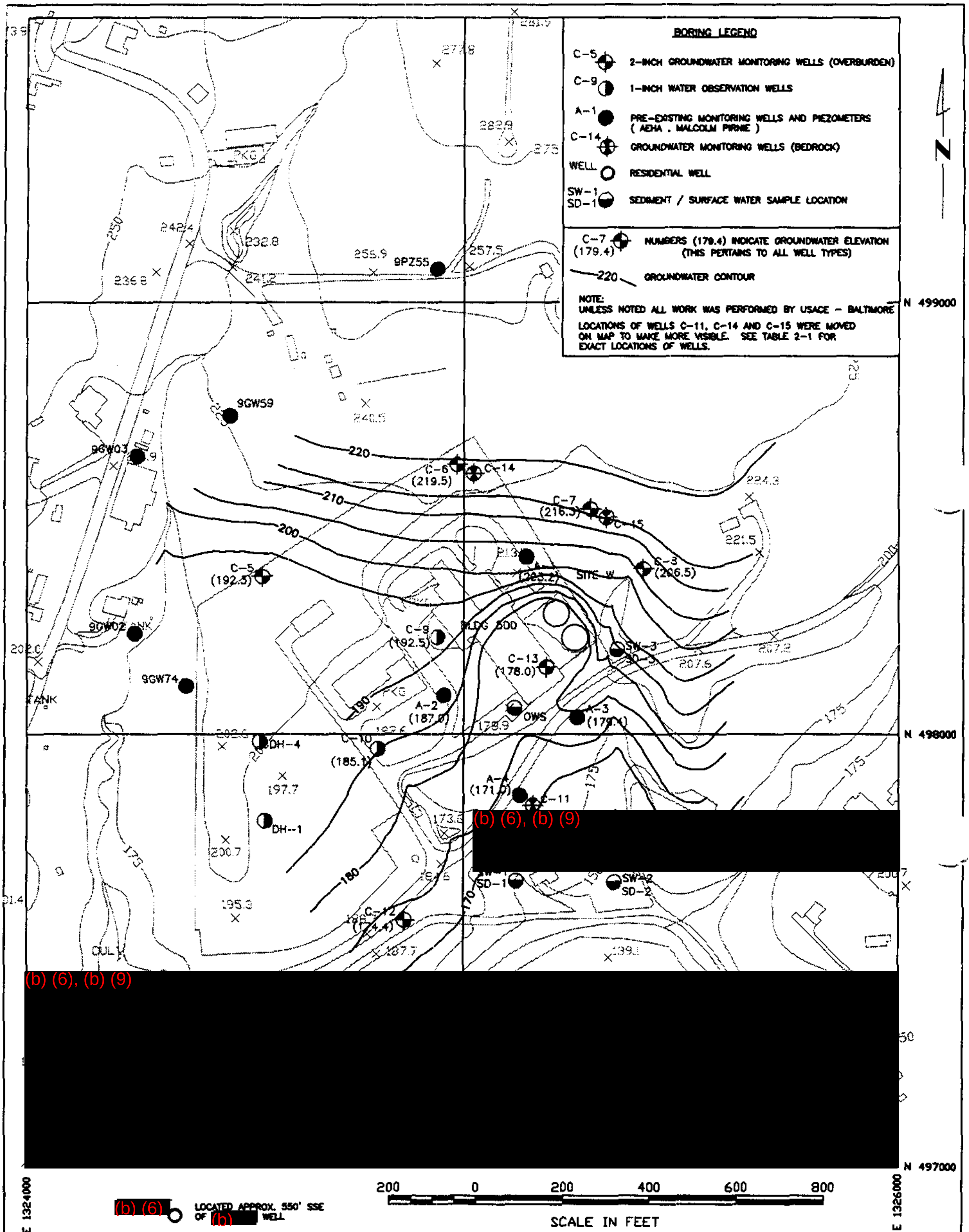


US Army Corps of Engineers

CROSS SECTION B–B'

ADELPHI LABORATORY CENTER
ADELPHI, MARYLAND
BLDG. 500 REMEDIAL INVESTIGATION

SCALE: AS SHOWN	DATE: AUG 1997	FIGURE 3-3



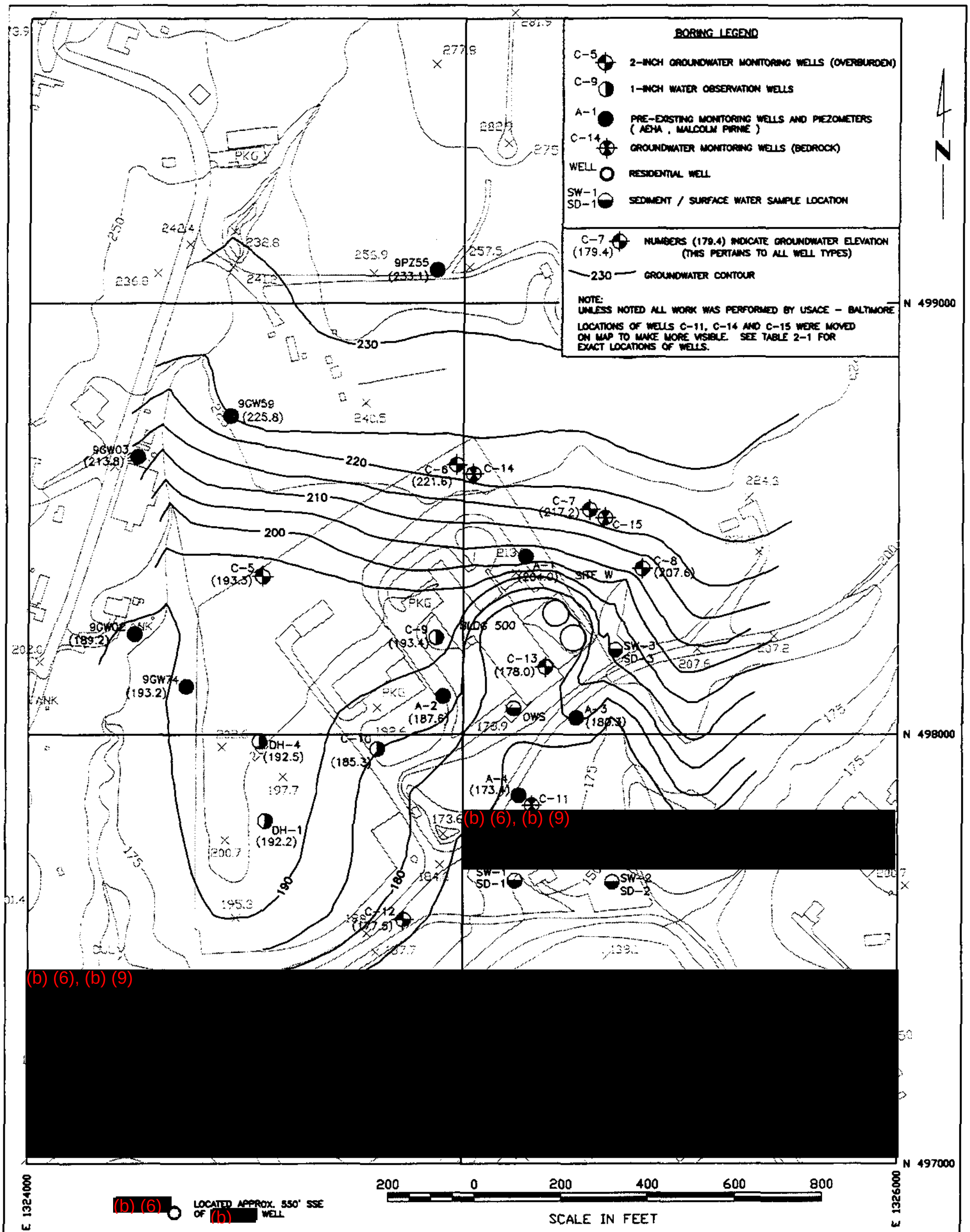
(b) (6) [redacted] LOCATED APPROX. 550' SSE OF (b) [redacted] WELL

US Army Corps of Engineers Baltimore District

POTENTIOMETRIC SURFACE MAP
ADELPHI LABORATORY CENTER
ADELPHI, MARYLAND
BLDG. 500 REMEDIAL INVESTIGATION

DATE: JAN 1998	SCALE: AS SHOWN
WATER ELEVATION DATE: 13 AUG 96	
	Fig 3-4

S:\HTRW\ARL-ADEL\B500-97\FIG_3-4.DWG

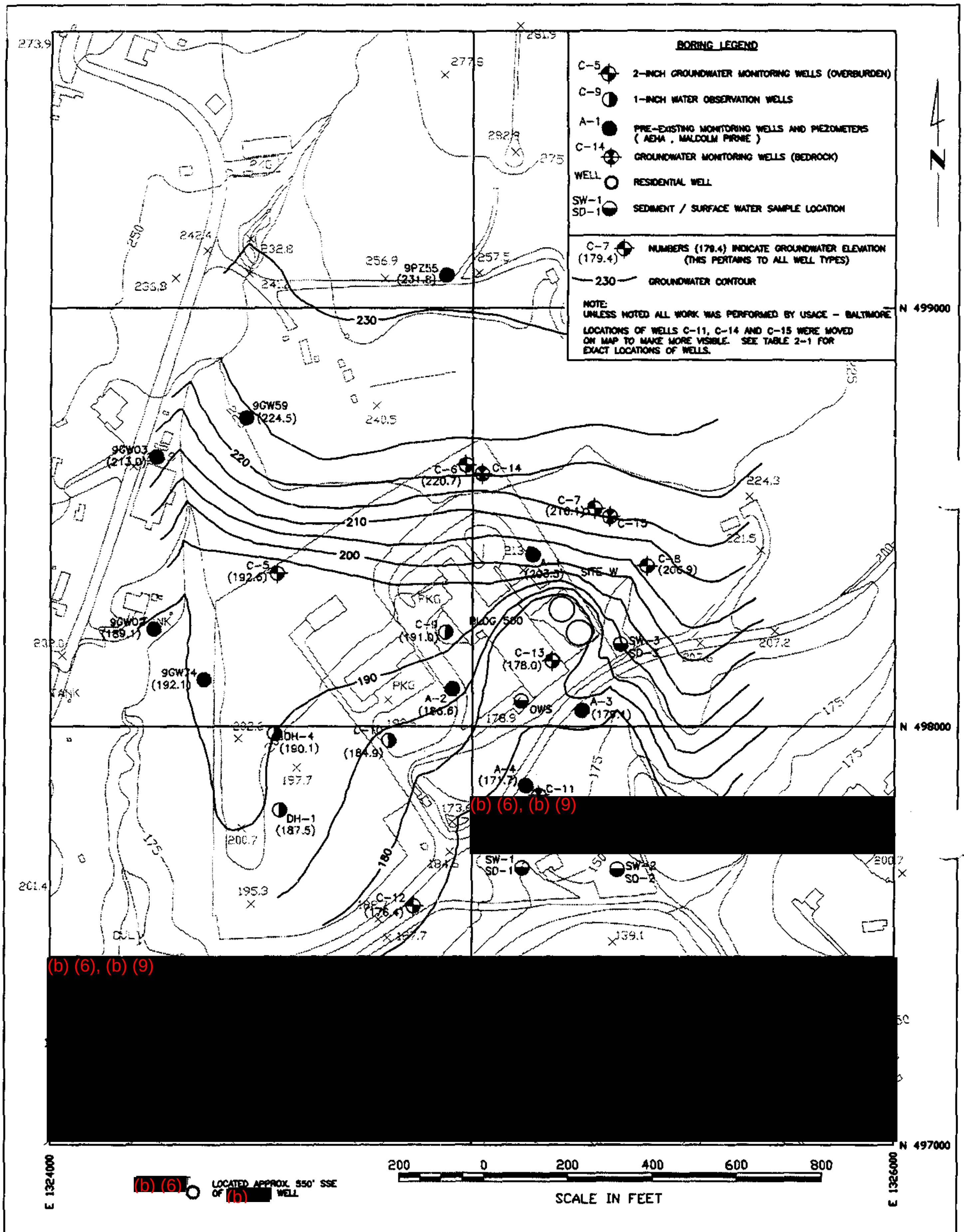


US Army Corps of Engineers Baltimore District

POTENTIOMETRIC SURFACE MAP
ADELPHI LABORATORY CENTER
ADELPHI, MARYLAND
BLDG. 500 REMEDIAL INVESTIGATION

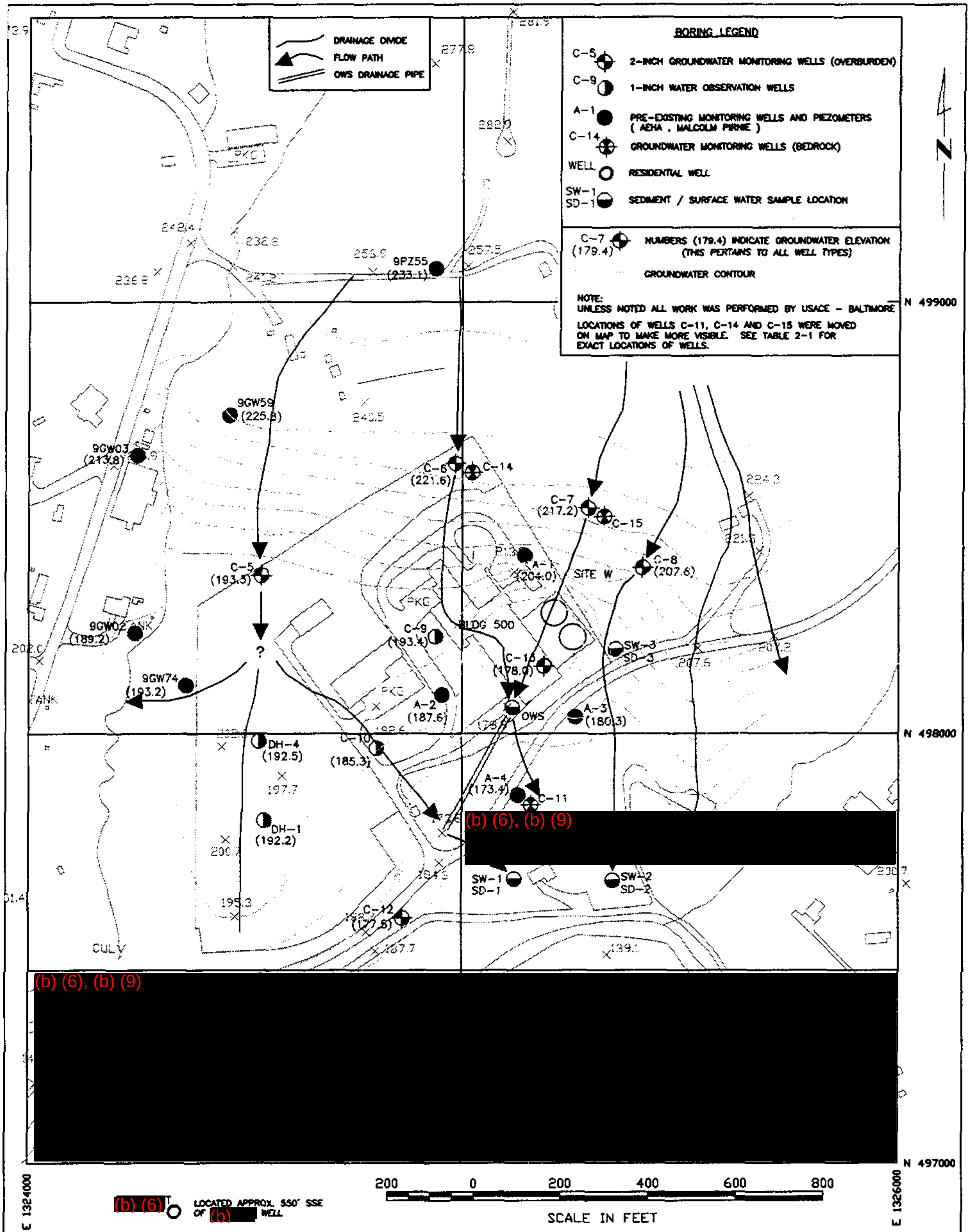
DATE: JAN 1998	SCALE: AS SHOWN
WATER ELEVATION DATE: 24 FEB 97	
	Fig 3-5

S:\HTRW\ARL-ADEL\B500-97\FIG_3-5.DWG



US Army Corps of Engineers Baltimore District	POTENTIOMETRIC SURFACE MAP ADELPHI LABORATORY CENTER ADELPHI, MARYLAND BLDG. 500 REMEDIAL INVESTIGATION	DATE: JAN 1998 SCALE: AS SHOWN WATER ELEVATION DATE: 27 MAY 97 Fig 3-6

S:\HTRW\ARL-ADEL\B500-97\FIG_3-6.DWG

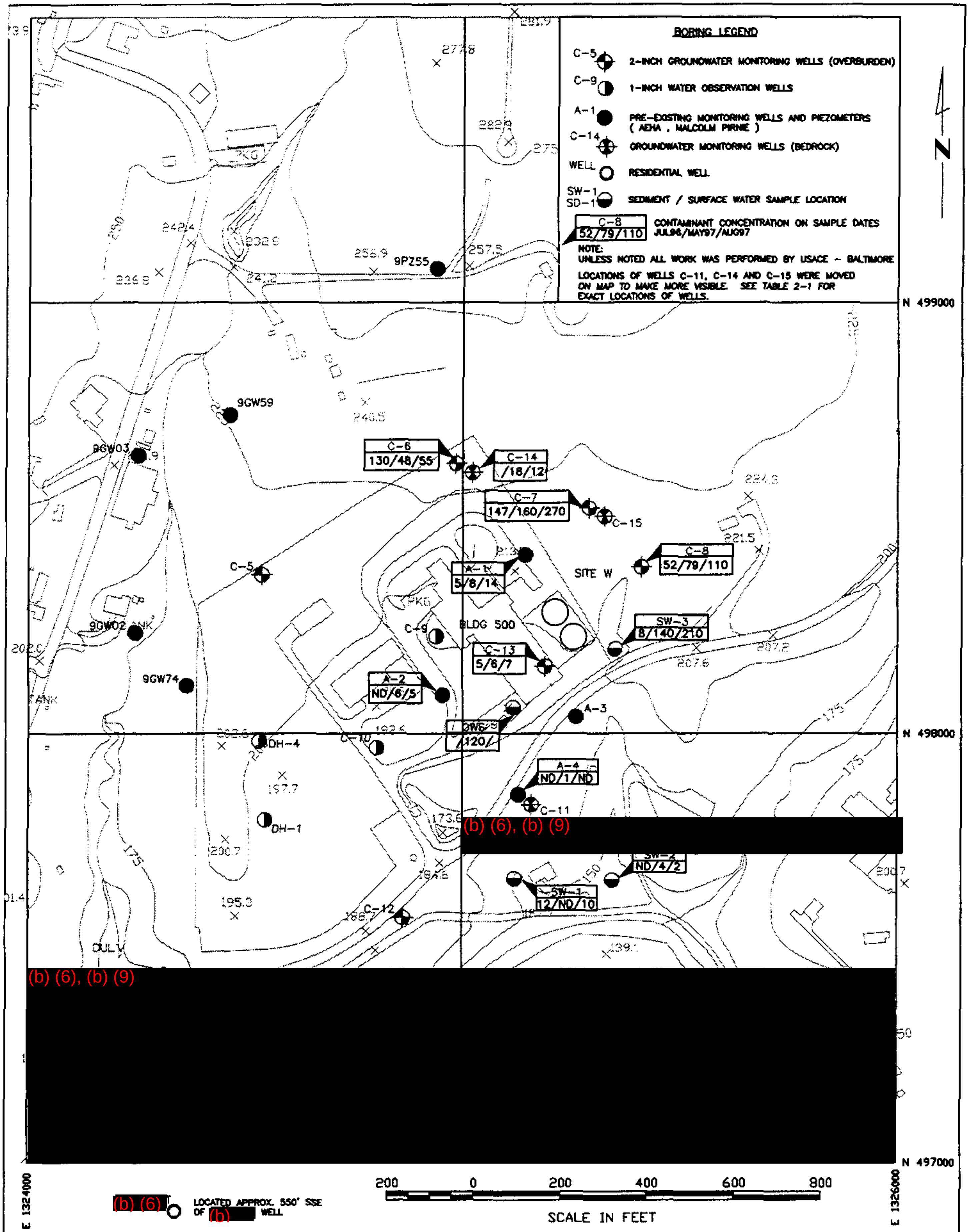


US Army Corps of Engineers Baltimore District

GROUNDWATER FLOW MAP
ADELPHI LABORATORY CENTER
ADELPHI, MARYLAND
BLDG. 500 REMEDIAL INVESTIGATION

DATE: JAN 1998	SCALE: AS SHOWN
WATER ELEVATION DATE: 24 FEB 97	
	Fig 3-7

S:\HTRW\ARL-ADEL\B500-97\FIG_3-7B.DWG

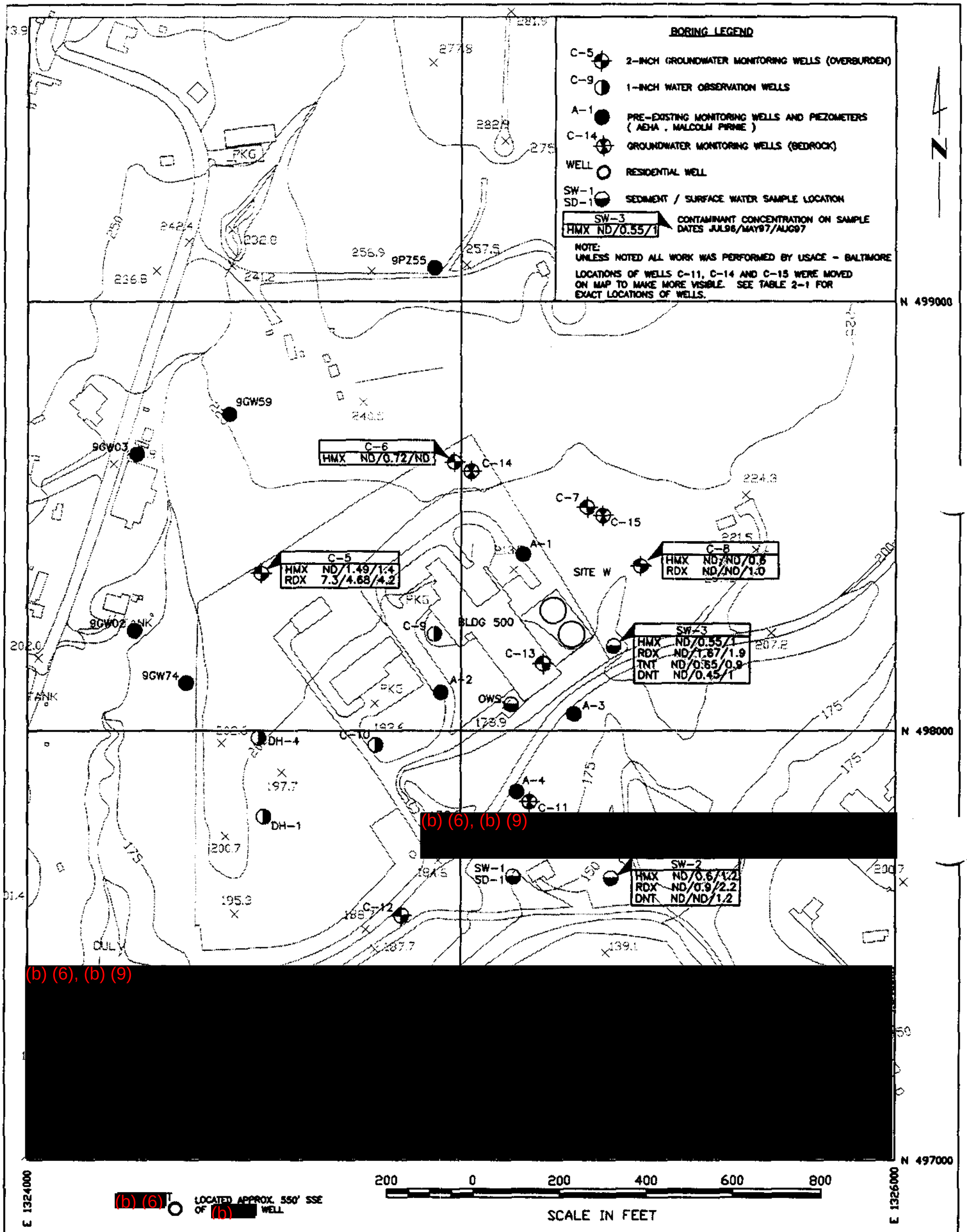


US Army Corps of Engineers Baltimore District

TCE CONCENTRATION MAP
ADELPHI LABORATORY CENTER
ADELPHI, MARYLAND
BLDG. 500 REMEDIAL INVESTIGATION

DATE: JAN 1998	SCALE: AS SHOWN
CONCENTRATION UNITS: ug/l	
	Fig 4-1

T:\HTRW\ARL-ADEL\B500-97\FIG_4-1.DWG



US Army Corps of Engineers Baltimore District

EXPLOSIVES CONCENTRATION MAP
ADELPHI LABORATORY CENTER
ADELPHI, MARYLAND
BLDG. 500 REMEDIAL INVESTIGATION

DATE: JAN 1998 | SCALE: AS SHOWN

CONCENTRATION UNITS: ug/l

Fig 4-2

T:\HTRW\ARL-ADEL\B500-97\FIG_4-2.DWG

TABLES

TABLE 2-1

ADELPHI LABORATORY CENTER
BLDG. 500 REMEDIAL INVESTIGATION
WELL SURVEY AND CONSTRUCTION SUMMARY

WELL	MD State Plane (NAD 83) Northing	MD State Plane (NAD 83) Easting	WELL DIAMETER (in)	SURFACE ELEVATION (ft)	TOP OF PVC CASING ELEV. (ft)	BOTTOM OF BOREHOLE (ft)	SCREEN INTERVAL (ft)
A-1	498411	1325143	2	215.9	217.79	16.4	6.4-16.4
A-2	498088	1324952	2	191.3	191.33	31.4	16.4-31.4
A-3	498037	1325260	2	195.0	197.02	31.0	16.0-31.0
A-4	497856	1325127	2	187.4	189.72	30.8	10.8-30.8
C-5	498365	1324536	2	213.5	215.24	36.0	16.0-36.0
C-6	498624	1324983	2	232.5	234.47	31.5	9.1-29.1
C-7	498520	1325289	2	220.6	222.49	23.5	2.8-22.8
C-8	498383	1325412	2	211.6	213.17	23.5	3.4-23.4
C-9	498224	1324937	1	203.2	204.47	24.5	4.5-24.5
C-10	497965	1324801	1	189.8	191.93	24.9	4.9-24.9
C-11	497847	1325145	2	187.5	189.70	74.6	64.6-74.6
C-12	497568	1324861	2	188.0	189.95	33.3	5.3-25.3
C-13	498155	1325188	2	180.5	181.10	12.0	1.0-11.0
C-14	498620	1324990	3.78	232.3	234.39	100.5	72-100.5*
C-15	498516	1325300	3.78	220.3	222.24	100.1	60-100.1*

* C-14 and C-15 are open borehole wells; depths given represent uncased zone. C-14 depths are for rehabilitated well, not for well as originally installed. See Section 2.12.2 for discussion of well rehabilitation.

Original coordinates translated from Washington Suburban Sanitary Commission grid to latitude and longitude. Latitude and longitude translated to MD State Plane (NAD27) and then to MD State Plane (NAD83) using CORPSCON V3.01. Translations are courtesy of WSSC. Units are feet.

TABLE 2-2

ADELPHI LABORATORY CENTER
BLDG. 500 REMEDIAL INVESTIGATION
SUMMARY OF SAMPLING PROGRAM

			Monitoring Wells													Residences			Surface Water				Sediment		
		Phase	A-1	A-2	A-3	A-4	C-5	C-6	C-7	C-8	C-11	C-12	C-13	C-14	C-15	[redacted]	[redacted]	[redacted]	SW-1	SW-2	SW-3	OWS	SD-1	SD-2	SD-3
VOCs		I	x	x	x	x	x	x	x	x	x	x	x			x	x	x	x	x	x		x	x	x
		II (1)	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	x	x	x	x	x
		II (2)	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	x		x	x	x
SVOCs	Full Suite	I	x	x	x	x	x	x	x	x	x	x	x			x	x	x	x	x	x		x	x	x
		II (1)	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	x	x	x	x	x
		II (2)														x	x						x	x	x
	BEHP only	I																							
		II (1)																							
		II (2)	x	x	x	x	x	x	x	x	x	x	x	x	x				x	x	x				
TPH-DRO		I																							
		II (1)	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	x	x	x	x	x
		II (2)			x	x					x		x			x	x						x	x	x
Explosives		I	x	x	x	x	x	x	x	x	x	x	x			x	x	x	x	x	x		x	x	x
		II (1)	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	x	x	x	x	x
		II (2)	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	x		x	x	x
Pesticides/PCBs		I	x	x	x	x	x	x	x	x	x	x	x			x	x	x	x	x	x		x	x	x
		II (1)																							
		II (2)																							
Cyanide		I																							
		II (1)	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	x	x	x	x	x
		II (2)																							
Metals	TAL (tot)	I	x	x	x	x	x	x	x	x	x	x	x			x	x	x	x	x	x		x	x	x
		II (1)	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	x	x	x	x	x
		II (2)														x	x								
	TAL (diss)	I	x	x	x	x	x	x	x	x	x	x	x			x	x	x	x	x	x				
		II (1)	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	x	x			
		II (2)														x	x								
	Cd (diss)	I																							
		II (1)	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	x	x			
		II (2)			x	x					x					x	x								

TABLE 2-2 (CONT.)

ADELPHI LABORATORY CENTER
BLDG. 500 REMEDIAL INVESTIGATION
SUMMARY OF SAMPLING PROGRAM

			Monitoring Wells													Residences			Surface Water				Sediment		
		Phase	A-1	A-2	A-3	A-4	C-5	C-6	C-7	C-8	C-11	C-12	C-13	C-14	C-15	[redacted]	[redacted]	[redacted]	SW-1	SW-2	SW-3	OWS	SD-1	SD-2	SD-3
Metals	Cd (tot)	I																							
		II (1)	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	x	x			
		II (2)														x	x								
	Tl (diss)	I																							
		II (1)	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	x	x			
		II (2)	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	x				
	Tl (tot)	I																							
		II (1)	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	x	x			
		II (2)														x	x								
	Sb (diss)	I																							
		II (1)	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	x	x			
		II (2)																							
	Sb (tot)	I																							
		II (1)	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	x	x			
		II (2)																							
	Be (diss)	I																							
		II (1)	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	x	x			
		II (2)																							
	Be (tot)	I																							
		II (1)	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	x	x			
		II (2)																							

Abbreviations:

Charl	[redacted]	TAL	Target Analyte List	I	Phase I (July 1996)
Light	[redacted]	tot	total	II (1)	Phase II, Round 1 (May 1997)
VOCs	Volatile organic compounds	diss	dissolved	II (2)	Phase II, Round 2 (August 1997)
SVOCs	Semi-volatile organic compounds	Cd	Cadmium	x	Analyzed for indicated parameters
BEHP	Bis(2-ethylhexyl)phthalate	Tl	Thallium		
TPH-DRO	Total petroleum hydrocarbons-deisel range organic	Sb	Antimony		
PCBs	Polychlorinated biphenyls	Be	Beryllium		

TABLE 3-1

ADELPHI LABORATORY CENTER
BLDG. 500 REMEDIAL INVESTIGATION
SUMMARY OF GEOTECHNICAL RESULTS

WELL ID #	DEPTH INTERVAL (ft)	DESCRIPTION	USCS ID	% LOI
C-5	20.0-21.5	clayey sand w/gravel	SC	0.8
C-5	30.0-31.5	poorly graded gravel w/silt and sand	GP-GM	1.0
C-6	10.0-11.5	clayey gravel w/sand	GC	1.9
C-6	25.0-26.5	clayey sand w/gravel	SC	2.1
C-7	20.0-21.5	clayey sand w/gravel	SC	0.6
C-8	15.0-16.5	clayey gravel w/sand	GC	0.2
C-9	12.5-14.0	clayey gravel w/sand	GC	0.4
C-10	15.0-16.5	silty sand	SM	3.5
C-14	35.0-36.5	clayey sand w/ trace rock	SC	n.d.
C-14	40.0-41.07	clayey sand w/ trace rock	SC	n.d.
C-14	45.0-45.65	clayey sand w/ trace rock	SC	2.3
C-14	50.0-50.67	clayey sand w/ trace rock	SC	n.d.
C-15	35.0-36.5	clayey sand w/ trace rock	SC	n.d.
C-15	40.0-41.5	silty clayey sand w/ trace gravel	SC-SM	2.7
C-15	45.0-46.5	clayey sand	SC	n.d.
C-15	50.0-50.7	clayey sand	SC	n.d.

*USCS - Unified Soil Classification System
% LOI - percent loss on ignition
n.d. - not determined

TABLE 3-2

ADELPHI LABORATORY CENTER
BLDG. 500 REMEDIAL INVESTIGATION
HYDRAULIC CONDUCTIVITY VALUES

WELL OR BORING	**TYPE OF TEST**	**HYDRAULIC CONDUCTIVITY (ft/day)**
C-6	slug test	6.2
C-7	slug test	2.6
C-8	slug test	2.1
C-9 (10.33-11.83 ft bgs)	in situ test	0.35
C-9 (18.5-20.0 ft bgs)	in situ test	0.15
C-9 (22.67-24.17 ft bgs)	in situ test	0.01
C-12	slug test	6.0
C-14	slug test	0.0033
C-15	slug test	0.0040

bgs - below ground surface

TABLE 3-3

ADELPHI LABORATORY CENTER
BLDG. 500 REMEDIAL INVESTIGATION
WATER ELEVATION DATA

Well	Well Type Screened Interval	Top of Casing Elevation (ft AMSL*)	13-Aug-96 Depth to Water (ft)	Water Level Elevation (ft AMSL*)	24-Feb-97 Depth to Water (ft)	Water Level Elevation (ft AMSL*)	27-May-97 Depth to Water (ft)	Water Level Elevation (ft AMSL*)
A-1	Overburden	217.79	14.60	203.19	13.84	203.95	14.50	203.29
A-2	Overburden	191.33	4.35	186.98	3.76	187.57	4.73	186.60
A-3	Overburden	197.02	17.58	179.44	16.75	180.27	17.90	179.12
A-4	Overburden	189.72	18.70	171.02	16.36	173.36	18.04	171.68
C-5	Overburden	215.24	22.92	192.32	21.90	193.34	22.62	192.62
C-6	Overburden	234.47	15.00	219.47	12.90	221.57	13.80	220.67
C-7	Overburden	222.49	6.17	216.32	5.26	217.23	6.43	216.06
C-8	Overburden	213.17	6.68	206.49	5.60	207.57	6.28	206.89
C-9	Overburden	204.47	11.94	192.53	11.10	193.37	13.43	191.04
C-10	Overburden	191.93	6.85	185.08	6.65	185.28	7.02	184.91
C-11	Bedrock	189.70	25.29	164.41	20.34	169.36	24.68**	165.02**
C-12	Over/Sap	189.95	15.51	174.44	12.44	177.51	13.57	176.38
C-13	Overburden	180.10	2.10	178.00	2.09	178.01	2.10	178.00
C-14	Bedrock	234.39	-	-	-	-	16.84	217.55
C-15	Bedrock	222.24	-	-	-	-	8.14	214.10
DH-1†	Overburden	200.95	-	-	8.73	192.22	13.42	187.53
DH-4†	Overburden	204.64	-	-	12.14	192.50	14.58	190.06
9GW02	Saprolite	197.62	-	-	8.43	189.19	8.52	189.10
9GW03	Saprolite	222.98	-	-	9.19	213.79	9.94	213.04
9PZ55	Over/Sap	262.73	-	-	29.60	233.13	30.89	231.84
9GW59	Overburden	231.96	-	-	6.19	225.77	7.48	224.48
9GW74	Saprolite	201.15	-	-	7.90	193.25	9.09	192.06

* Elevations are given in feet above mean sea level (AMSL).

† Elevations for DH-1 and DH-4 are based on surveyed ground surface elevations plus PVC stick-up.

** Not believed to be static water level. Well had been sampled and was still recovering.

TABLE 4-1

ADELPHI LABORATORY CENTER
BLDG. 500 REMEDIAL INVESTIGATION
SUMMARY OF ANALYTICAL RESULTS FOR SEDIMENT AND SOIL SAMPLES

	MDL				SD-1** Surface			SD-2** Surface			SD-3** Surface			SD-3** Duplicate
	1996	May-97	Aug-97	SSL	Jul-96	May-97	Aug-97	Jul-96	May-97	Aug-97	Jul-96	May-97	Aug-97	May-97
Volatile Organic Compounds														
cis-1,2-DCE	0.004	0.010		782 N	--	--	--	--	--	--	--	0.077	--	0.022
1,1,2,2-PCA	0.003	0.010	0.024	3.2 C	--	--	--	--	--	--	--	--	0.003 J	--
1,1,1-TCA	0.005	0.010	0.024		--	--	--	--	--	--	--	--	--	--
TCE	0.002	0.010	0.024	58.2 C	0.007	--	0.004 J	--	0.002 J	--	--	0.016	0.042	0.035
Toluene	0.003	0.010	0.024	15,643 N	--	--	--	--	--	0.051	--	--	--	--
Xylene	0.005	0.010	0.024	156,429 N	--	--	--	--	--	--	--	--	--	--
1,2-DCE (total)			0.024				--			0.009 J			0.006 J	
Semivolatile Organic Compounds														
Bis(2-ethylhexyl)phthalate	3.3	0.33	0.79	45.7 C	--	0.098 B	0.380 J	--	0.190 B	0.120 J	--	--	0.150 J	--
Benzo(a)pyrene	3.3	0.33	0.79	0.088 C	--	--	1.0	--	0.810	--	--	--	--	--
Explosive Organic Compounds														
HMX	0.58	0.82	0.0705		--	--	--	--	--	--	--	--	--	--
RDX	0.56	0.78	0.0509		--	--	--	--	--	--	--	--	--	--
2,4,6-TNT	1.08	1.52	0.0356		--	--	--	--	--	--	--	--	--	--
4-Amino-2,6-DNT	0.71	0.99	0.0409		--	--	--	--	--	--	--	--	--	--
Petroleum Hydrocarbons														
TPH-DRO		10	4.8		nd	--	--	nd	88	--	nd	170 K	--	240 K
Heavy Oil			24				9.1 J			--			9.1 J	
Metals														
Ba	10	2		5,475 N	26	23	nd	12	17	nd	38	18	nd	27
Cd	0.2	0.5		78.2 N	1.5	0.52	nd	0.52	0.65	nd	0.85	--	nd	0.5
Pb	0.5	0.44			19	11.1	nd	17	7.2	nd	31	11.2	nd	13.3
Ni	1	1		1,564 N	22	8.2	nd	14	47	nd	6.3	6.2	nd	6.3

TABLE 4-1 (CONT.)

ADELPHI LABORATORY CENTER
BLDG. 500 REMEDIAL INVESTIGATION
SUMMARY OF ANALYTICAL RESULTS FOR SEDIMENT AND SOIL SAMPLES

	BDA	TB-2	TB-3	TB-4	TB-4
	14-20 in	4-6 ft	1-2.8 ft	5.2-6.5 ft	Duplicate
	Jul-96	May-96	May-96	May-96	May-96
Volatile Organic Compounds					
cis-1,2-DCE	--	--	--	--	--
1,1,2,2-PCA	--	--	--	--	--
1,1,1-TCA	--	--	--	--	--
TCE	--	--	--	--	--
Toluene	--	--	--	--	--
Xylene	--	--	0.011	--	--
1,2-DCE (total)					
Semivolatile Organic Compounds					
Bis(2-ethylhexyl)phthalate	3.7	--	--	--	--
Benzo(a)pyrene	--	--	--	--	--
Explosive Organic Compounds					
HMX	--	nd	nd	nd	nd
RDX	--	nd	nd	nd	nd
2,4,6-TNT	--	nd	nd	nd	nd
4-Amino-2,6-DNT	--	nd	nd	nd	nd
Petroleum Hydrocarbons					
TPH-DRO	nd	nd	nd	nd	nd
Heavy Oil					
Metals					
Ba	62	nd	nd	nd	nd
Cd	--	nd	nd	nd	nd
Pb	--	nd	nd	nd	nd
Ni	9.1	nd	nd	nd	nd

TABLE 4-1 (CONT.)

ADELPHI LABORATORY CENTER
BLDG. 500 REMEDIAL INVESTIGATION
SUMMARY OF ANALYTICAL RESULTS FOR SEDIMENT AND SOIL SAMPLES

Note: Reported are analytes of concern identified from surface water and groundwater samples and compounds that had results above Soil Screening Levels. SSLs are calculated as risk-based, site specific values, as specified in Soil Screening Guidance: Technical Background Document (EPA/540/R-95/128). A dilution attenuation factor of 1 has been assigned to the SSLs. Values in shaded **bold** print are above SSL.
All values are mg/kg.

** During the July 1996 sampling event, samples SD-1, SD-2 and SD-3 were labeled SW-1, SW-2 and SW-3, respectively. To avoid confusing sediment samples at SW-1, SW-2 and SW-3 with surface water samples having the same label, sediment samples in subsequent rounds are given the designation SD.

Abbreviations:

SSL	Soil Screening Level
N	SSL calculated as noncarcinogenic
C	SSL calculated as carcinogenic
MDL	Method detection limit or Contract Required Quantitation Limit
J	Analyte present. Reported value may not be accurate or precise (estimated value).
K	Analyte present. Reported value may be biased high. Actual value is expected to be lower.
B	Not detected substantially above the level reported in laboratory or field blanks.
--	Not detected. Includes some values where quantitation limit may be inaccurate or imprecise.
nd	Not determined. Sampling was curtailed to reflect known contaminants.

TABLE 4-2

ADELPHI LABORATORY CENTER
BLDG. 500 REMEDIAL INVESTIGATION
SUMMARY OF ANALYTICAL RESULTS FOR
SURFACE WATER SAMPLES

	MDL			MD AWQC				EPA AWQC				EPA RBC
				Aquatic Life		Human Health		Aquatic Life		Human Health		Tap water
				Fresh Water		Drink Water	Fish Consump	Freshwater		Water & Org.	Org. only	
	1996	May-97	Aug-97	Acute	Chronic			CMC	CCC			
Volatile Organic Compounds												
cis-1,2-DCE	4	1	1									61
1,1,2,2-PCA	3	1	1							0.17	11	
1,1,1-TCA	5	1	1			200						
TCE	2	1	1			5	807			2.7	81	
Toluene	3	1	1							6800	200,000	
Xylene	5	1	1									12,000
Semivolatile Organic Compounds												
Bis(2-ethylhexyl)phthalate	10	5	5							1.8	5.9	
Benzo(a)pyrene	10	5	5							0.0028	0.031	
Explosive Organic Compounds												
HMX	5.1	0.3	1.3									1800
RDX	6.4	0.66	1.3									0.61
2,4,6-TNT	2.5	0.21	0.6									2.2
4-Amino-2,6-DNT	3.3	0.29	0.6									
Petroleum Hydrocarbons												
TPH-DRO		1000	250									
Total Unknown			250									
Metals (Total/Dissolved)												
Pb	2	1	1.3	82	3.2	50		65	2.5			
Ni	20	20	1.1	1400	160	100	4600	1400	160	610	4600	
Cd	5	1	3	3.9	1.1	5		3.7	1			

TABLE 4-2 (CONT.)

ADELPHI LABORATORY CENTER
BLDG. 500 REMEDIAL INVESTIGATION
SUMMARY OF ANALYTICAL RESULTS FOR
SURFACE WATER SAMPLES

	SW-1			SW-2		
	Jul-96	**May-97**	**Aug-97**	**Jul-96**	**May-97**	**Aug-97**
Volatile Organic Compounds						
cis-1,2-DCE	--	--	2	--	--	--
1,1,2,2-PCA	**5**	--	**2**	--	**3**	**3**
1,1,1-TCA	--	--	--	--	--	--
TCE	**12**	--	**10**	--	4	2
Toluene	--	--	--	--	--	--
Xylene	--	--	--	--	--	--
Semivolatile Organic Compounds						
Bis(2-ethylhexyl)phthalate	--	--	**2 JB**	--	1 B	--
Benzo(a)pyrene	--	--	--	--	--	--
Explosive Organic Compounds						
HMX	--	--	--	--	0.6	1.2 J
RDX	--	--	--	--	**0.9**	**2.2**
2,4,6-TNT	--	--	--	--	--	--
4-Amino-2,6-DNT	--	--	--	--	--	1.2
Petroleum Hydrocarbons						
TPH-DRO	--	--	nd	--	--	nd
Total Unknown			nd			nd
Metals (Total/Dissolved)						
Pb	-- --	-- --	nd nd	-- --	[1] B --	nd nd
Ni	-- --	-- --	nd nd	-- --	-- --	nd nd
Cd	-- --	-- --	nd nd	-- --	-- --	nd nd

TABLE 4-2 (CONT.)

ADELPHI LABORATORY CENTER
BLDG. 500 REMEDIAL INVESTIGATION
SUMMARY OF ANALYTICAL RESULTS FOR
SURFACE WATER SAMPLES

	SW-3						OWS	
	Jul-96		May-97		Aug-97		May-97	
Volatile Organic Compounds								
cis-1,2-DCE	7		18		22		21	
1,1,2,2-PCA	--		12		8		11	
1,1,1-TCA	--		--		--		--	
TCE	8		140 *		210 *		120 *	
Toluene	--		--		--		--	
Xylene	--		--		--		--	
Semivolatile Organic Compounds								
Bis(2-ethylhexyl)phthalate	--		--		--		18 B	
Benzo(a)pyrene	--		--		--		3 J	
Explosive Organic Compounds								
HMX	--		0.55		1.0 J		--	
RDX	--		1.67		1.9		--	
2,4,6-TNT	--		0.65		0.9		--	
4-Amino-2,6-DNT	--		0.45		1		--	
Petroleum Hydrocarbons								
TPH-DRO	--		--		nd		31000 K	
Total Unknown					nd			
Metals (Total/Dissolved)								
Pb	12	2	--	--	nd	nd	142	--
Ni	--	--	23	21	nd	nd	140	--
Cd	--	--	--	--	nd	nd	4.9	--

TABLE 4-2 (CONT.)

ADELPHI LABORATORY CENTER
BLDG. 500 REMEDIAL INVESTIGATION
SUMMARY OF ANALYTICAL RESULTS FOR
SURFACE WATER SAMPLES

Note: For VOCs, SVOCs, explosives and petroleum hydrocarbons, only compounds that had results above detection limits of 1996 or 1997 are reported.
For metals, only those metals with results above detection limits and screening criteria are reported. Values in shaded **bold** print are above screening criteria.
All values are µg/l.

Abbreviations:

AWQC	Ambient Water Quality Criteria from COMAR Title 26, Subtitle 8, Chapter 2 (March 25, 1996) or EPA Title 40, Part 131
CCC	Criterion Continuous Concentration
CMC	Criterion Maximum Concentration
MDL	Method detection limit or Contract Required Quantitation Limit
RBC	EPA Region III Tap Water Risk-Based Concentration (13 Aug 97). Provided only for those compounds lacking MD or EPA AWQC.
[ ]	Analyte present. Value approaches the instrument detection limit, but less than the quantitation limit. The quantitation may not be accurate.
J	Analyte present. Reported value may not be accurate or precise (estimated value).
K	Analyte present. Reported value may be biased high. Actual value is expected to be lower.
B	Not detected substantially above the level reported in laboratory or field blanks.
*	Reported from diluted analysis.
--	Not detected. Includes some values where quantitation limit may be inaccurate or imprecise.
nd	Not determined. Sampling was curtailed to focus on wells with known contaminants and wells downgradient of known contamination.

TABLE 4-3

ADELPHI LABORATORY CENTER
BLDG. 500 REMEDIAL INVESTIGATION
SUMMARY OF ANALYTICAL RESULTS
FOR GROUNDWATER SAMPLES

	MDL			Screen	A-1			A-2		
	1996	May-97	Aug-97	Criteria	Jul-96	May-97	Aug-97	Jul-96	May-97	Aug-97
Volatile Organic Compounds										
cis-1,2-DCE	4	1	1	70[1]	5	7	8	--	2	2
1,1,2,2-PCA	3	1	1	0.052[2]	--	1	--	--	--	--
1,1,1-TCA	5	1	1	200[1]	--	--	--	--	--	--
TCE	2	1	1	5[1]	5	8	14	--	6	5
Toluene	3	1	1	1000[1]	--	--	--	--	--	--
Xylene	5	1	1	10000[1]	--	--	--	--	--	--
Semivolatile Organic Compounds										
Bis(2-ethylhexyl)phthalate	10	5	5	6[1]	28	1 B	1 JB	--	8 B	8 B
Benzo(a)pyrene	10	5	5	0.2[1]	--	--	--	--	--	--
Explosive Organic Compounds										
HMX	5.1	0.3	1.3	1800[2]	--	--	--	--	--	--
RDX	6.4	0.66	1.3	0.61[2]	--	--	--	--	--	--
2,4,6-TNT	2.5	0.21	0.6	2.2[2]	--	--	--	--	--	--
4-Amino-2,6-DNT	3.3	0.29	0.6		--	--	--	--	--	--
Petroleum Hydrocarbons										
TPH-DRO		1000	250		--	--	nd	--	--	nd
Total Unknown			250				nd			--
Metals (Total/Dissolved)										
Pb	2	1	1.3	15[3]	6 --	-- --	nd nd	5 --	[2] L --	nd nd
Ni	20	20	1.1	100[1]	-- --	-- --	nd nd	20 40	56 72	nd nd
Cd	5	1	3	5[1]	-- --	-- --	nd nd	-- --	19 14	nd 7.26

TABLE 4-3 (CONT.)

ADELPHI LABORATORY CENTER
BLDG. 500 REMEDIAL INVESTIGATION
SUMMARY OF ANALYTICAL RESULTS
FOR GROUNDWATER SAMPLES

	A-3			A-4		
	Jul-96	**May-97**	**Aug-97**	**Jul-96**	**May-97**	**Aug-97**
Volatile Organic Compounds						
cis-1,2-DCE	--	--	--	--	--	--
1,1,2,2-PCA	--	--	--	--	--	--
1,1,1-TCA	--	--	--	--	--	--
TCE	--	--	--	--	1	--
Toluene	--	--	--	--	--	--
Xylene	--	--	--	--	--	--
Semivolatile Organic Compounds						
Bis(2-ethylhexyl)phthalate	**31**	**39 B**	3 JB	--	**34 B**	**31**
Benzo(a)pyrene	--	--	--	--	--	--
Explosive Organic Compounds						
HMX	--	--	--	--	--	--
RDX	--	--	--	--	--	--
2,4,6-TNT	--	--	--	--	--	--
4-Amino-2,6-DNT	--	--	--	--	--	--
Petroleum Hydrocarbons						
TPH-DRO	--	--	--	--	--	--
Total Unknown			--			--
Metals (Total/Dissolved)						
Pb	2 --	-- --	nd nd	-- --	[1.4] L --	nd nd
Ni	30 30	30 38	nd nd	-- --	-- --	nd nd
Cd	7 --	4.5 4.1	nd 2.58	-- --	-- --	nd --

TABLE 4-3 (CONT.)

ADELPHI LABORATORY CENTER
BLDG. 500 REMEDIAL INVESTIGATION
SUMMARY OF ANALYTICAL RESULTS
FOR GROUNDWATER SAMPLES

	C-5				C-6				
	Jul-96	**May-97**	**Aug-97**	**Aug-97 (dup.)**	**Jul-96**	**Jul-96 (dup.)**	**May-97**	**May-97 (dup.)**	**Aug-97**
Volatile Organic Compounds									
cis-1,2-DCE	--	--	--	nd	--	12	5	6	6
1,1,2,2-PCA	--	--	--	nd	7	7	4	4	2
1,1,1-TCA	--	--	--	nd	--	--	--	--	--
TCE	--	--	1	nd	130	150	48 *	48 J	55 *
Toluene	--	--	--	nd	--	--	--	--	--
Xylene	--	--	--	nd	--	--	--	--	--
Semivolatile Organic Compounds									
Bis(2-ethylhexyl)phthalate	--	52 B	--	nd	--	32	580* B	160* B	4 JB
Benzo(a)pyrene	--	--	--	nd	--	--	--	--	--
Explosive Organic Compounds									
HMX	--	1.49	1.6	1.4	--	--	0.72	0.88	--
RDX	7.3	4.68	5	4.2	--	--	--	--	--
2,4,6-TNT	--	--	--	--	--	--	--	--	--
4-Amino-2,6-DNT	--	--	--	--	--	--	--	--	--
Petroleum Hydrocarbons									
TPH-DRO	--	--	nd	nd	--	--	--	1200	nd
Total Unknown			nd	nd					nd
Metals (Total/Dissolved)									
Pb	14 10	[1.1] L --	nd nd	nd nd	3 --	-- --	[1.8] B --	-- --	nd nd
Ni	-- --	-- --	nd nd	nd nd	-- --	-- --	-- --	-- --	nd nd
Cd	-- --	-- --	nd nd	nd nd	-- --	-- --	-- --	-- --	nd nd

TABLE 4-3 (CONT.)

ADELPHI LABORATORY CENTER
BLDG. 500 REMEDIAL INVESTIGATION
SUMMARY OF ANALYTICAL RESULTS
FOR GROUNDWATER SAMPLES

	C-7				C-8		
	Jul-96	**May-97**	**May-97 (dup.)**	**Aug-97**	**Jul-96**	**May-97**	**Aug-97**
Volatile Organic Compounds							
cis-1,2-DCE	16	22	22	23	--	9	12
1,1,2,2-PCA	**4**	**11**	**10**	**10**	--	**5**	**4**
1,1,1-TCA		--	--	--	--	--	--
TCE	**147**	**160 ***	**140 ***	**270 ***	**52**	**79 ***	**110 ***
Toluene	--	--	--	--	--	--	--
Xylene	--	--	--	--	--	--	--
Semivolatile Organic Compounds							
Bis(2-ethylhexyl)phthalate	**29**	--	--	**13 B**	**14**	--	**110* B**
Benzo(a)pyrene	--	--	--	--	--	--	--
Explosive Organic Compounds							
HMX	--	--	--	--	--	--	0.6 J
RDX	--	--	--	--	--	--	**1.0 J**
2,4,6-TNT	--	--	--	--	--	--	--
4-Amino-2,6-DNT	--	--	--	--	--	--	--
Petroleum Hydrocarbons							
TPH-DRO	--	--	--	nd	--	--	nd
Total Unknown				nd			nd
Metals (Total/Dissolved)							
Pb	2 --	-- --	-- --	nd nd	3 --	-- --	nd nd
Ni	-- --	-- --	-- --	nd nd	30 30	-- --	nd nd
Cd	-- --	-- --	-- --	nd nd	-- --	-- --	nd nd

TABLE 4-3 (CONT.)

ADELPHI LABORATORY CENTER
BLDG. 500 REMEDIAL INVESTIGATION
SUMMARY OF ANALYTICAL RESULTS
FOR GROUNDWATER SAMPLES

	C-11			C-12		
	Jul-96	**May-97**	**Aug-97**	**Jul-96**	**May-97**	**Aug-97**
Volatile Organic Compounds						
cis-1,2-DCE	--	--	--	--	--	--
1,1,2,2-PCA	--	--	--	--	--	--
1,1,1-TCA	--	--	--	--	--	--
TCE	--	--	--	--	--	--
Toluene	--	--	--	--	--	--
Xylene	--	--	--	--	--	--
Semivolatile Organic Compounds						
Bis(2-ethylhexyl)phthalate	--	19 B	10	--	120* B	5 J
Benzo(a)pyrene	--	--	--	--	--	--
Explosive Organic Compounds						
HMX	--	--	--	--	--	--
RDX	--	--	--	--	--	--
2,4,6-TNT	--	--	--	--	--	--
4-Amino-2,6-DNT	--	--	--	--	--	--
Petroleum Hydrocarbons						
TPH-DRO	--	--	--	--	--	nd
Total Unknown			--			nd
Metals (Total/Dissolved)						
Pb	12 --	-- --	nd nd	-- --	[1.1] L --	nd nd
Ni	30 --	-- --	nd nd	-- --	-- --	nd nd
Cd	10 --	-- --	nd --	-- --	-- --	nd nd

TABLE 4-3 (CONT.)

ADELPHI LABORATORY CENTER
BLDG. 500 REMEDIAL INVESTIGATION
SUMMARY OF ANALYTICAL RESULTS
FOR GROUNDWATER SAMPLES

	C-13			C-14		C-15	
	Jul-96	**May-97**	**Aug-97**	**May-97**	**Aug-97**	**May-97**	**Aug-97**
Volatile Organic Compounds							
cis-1,2-DCE	--	1	2	5	4	--	--
1,1,2,2-PCA	--	--	--	--	--	--	--
1,1,1-TCA	14	1	1	--	--	--	--
TCE	5	6	7	18	12	--	--
Toluene	241	13	10	--	--	--	--
Xylene	--	--	--	--	--	--	--
Semivolatile Organic Compounds							
Bis(2-ethylhexyl)phthalate	--	--	1 JB	2 B	3 JB	--	2 JB
Benzo(a)pyrene	--	--	--	--	--	--	--
Explosive Organic Compounds							
HMX	--	--	--	--	--	--	--
RDX	--	--	--	--	--	--	--
2,4,6-TNT	--	--	--	--	--	--	--
4-Amino-2,6-DNT	--	--	--	--	--	--	--
Petroleum Hydrocarbons							
TPH-DRO	--	14000 K	--	--	nd	--	nd
Total Unknown			2400		nd		nd
Metals (Total/Dissolved)							
Pb	-- --	[2.6] B --	nd nd	[1.9] B 3.3 B	nd nd	[4.1] B --	nd nd
Ni	-- --	-- --	nd nd	-- --	nd nd	-- --	nd nd
Cd	-- --	-- --	nd nd	-- --	nd nd	-- --	nd nd

TABLE 4-3 (CONT.)

ADELPHI LABORATORY CENTER
BLDG. 500 REMEDIAL INVESTIGATION
SUMMARY OF ANALYTICAL RESULTS
FOR GROUNDWATER SAMPLES

	(b) [redacted]			(b) (6) [redacted]		
	Jul-96	**May-97**	**Aug-97**	**Jul-96**	**May-97**	**Aug-97**
Volatile Organic Compounds						
cis-1,2-DCE	--	--	--	--	--	--
1,1,2,2-PCA	--	--	--	--	--	--
1,1,1-TCA	--	--	--	--	--	--
TCE	--	--	--	--	--	--
Toluene	--	--	--	--	--	--
Xylene	--	--	--	--	--	--
Semivolatile Organic Compounds						
Bis(2-ethylhexyl)phthalate	31	--	--	--	--	--
Benzo(a)pyrene	--	--	--	--	--	--
Explosive Organic Compounds						
HMX	--	--	--	--	--	--
RDX	--	--	--	--	--	--
2,4,6-TNT	--	--	--	--	--	--
4-Amino-2,6-DNT	--	--	--	--	--	--
Petroleum Hydrocarbons						
TPH-DRO	--	--	--	--	--	--
Total Unknown			--			--
Metals (Total/Dissolved)						
Pb	2 / --	-- / --	1.43 / --	-- / --	262 / 27.1	-- / --
Ni	-- / --	-- / --	-- / --	-- / --	-- / --	3.24 / 3.82
Cd	-- / --	-- / --	-- / --	-- / --	-- / --	-- / --

TABLE 4-3 (CONT.)

ADELPHI LABORATORY CENTER
BLDG. 500 REMEDIAL INVESTIGATION
SUMMARY OF ANALYTICAL RESULTS
FOR GROUNDWATER SAMPLES

Note: For VOCs, SVOCs, explosives and petroleum hydrocarbons, only compounds that had results above detection limits of 1996 or 1997 are reported. For metals, only those metals with results above detection limits and screening criteria are reported. Values in shaded **bold** print are above screening criteria. All values are µg/l.

Screening Criteria:

[1] The lower of the Maximum Contaminant Level obtained from the Safe Drinking Water Act Primary Drinking Water Regulations (January 17, 1994) or COMAR Title 26, Subtitle 4, Chapter 1 (January 2, 1995).

[2] EPA Region III Tap Water Risk-Based Concentration (13 Aug 97)

[3] Value for Pb is an action level, which, strictly speaking, is not an MCL.

Abbreviations:

MCL	Maximum Contaminant Level
MDL	Method detection limit or Contract Required Quantitation Limit
[ ]	Analyte present. Value approaches the instrument detection limit, but less than the quantitation limit. The quantitation may not be accurate.
J	Analyte present. Reported value may not be accurate or precise (estimated value).
K	Analyte present. Reported value may be biased high. Actual value is expected to be lower.
L	Analyte present. Reported value may be biased low. Actual value is expected to be higher.
B	Not detected substantially above the level reported in laboratory or field blanks.
*	Reported from diluted analysis.
--	Not detected. Includes some values where quantitation limit may be inaccurate or imprecise.
nd	Not determined. Sampling was curtailed to focus on wells with known contaminants and wells downgradient of known contamination.

TABLE 6-1

ADELPHI LABORATORY CENTER
BLDG. 500 REMEDIAL INVESTIGATION
COMPARISON OF COC HIGHEST DETECTIONS
WITH REGULATORY LIMIT/GUIDANCE

COC	Highest Detected Level	Regulatory Limit or Guidance[1]
TCE in groundwater (GW)	270 µg/l in Phase II	MCL of 5 µg/l
Cd in GW	19 µg/l in Phase II	MCL of 5 µg/l
1,1,2,2-PCA in GW	11 µg/l in Phase II	RBC of 0.052 µg/l
RDX in GW	7.3 µg/l in Phase I	RBC of 0.61 µg/l
TCE in surface water (SW)	210 µg/l in Phase II	MD AWQC of 5.0 µg/l
1,1,2,2-PCA in SW	12 µg/l in Phase II	EPA AWQC of 0.17 µg/l
RDX in SW	2.2 µg/l in Phase II	RBC of 0.61 µg/l
BaP in sediment	1.0 mg/kg in Phase II	SSL of 0.088 mg/kg

[1] See Section 6.1.3 for explanation and discussion of regulatory limits and guidance.

TABLE 6-2

ADELPHI LABORATORY CENTER
BLDG. 500 REMEDIAL INVESTIGATION
CUMULATIVE SUMMARY TABLE FOR SITE COC

				LADE					
			Concentration	Carcinogenic	Non-Carcinogenic	CPS	RfD	Excess Cancer	Hazard
COC	Media	Pathway	mg/l or mg/kg	mg/kg-day	mg/kg-day	kg-day/mg	mg/kg/day	Cases	Quotient
TCE (adult)	GW	ingestion	0.27	$3.17x10^{-3}$	$7.40x10^{-3}$	$1.10x10^{-2}$	$6.00x10^{-3}$	$3.49x10^{-5}$	1.23 or 123%
			0.0609*	$7.16x10^{-4}$	$1.67x10^{-3}$	$1.10x10^{-2}$	$6.00x10^{-3}$	$7.88x10^{-6}$	0.28 or 28%
		inhalation	0.27	$9.53x10^{-5}$	$2.22x10^{-4}$	$6.00x10^{-3}$	N/D	$5.72x10^{-7}$	N/A
		dermal	0.27	$9.84x10^{-5}$	$2.30x10^{-4}$	$1.10x10^{-2}$	$6.00x10^{-3}$	$1.08x10^{-6}$	0.038 or 4%
	SW	dermal	0.27	$5.10x10^{-5}$	$1.19x10^{-4}$	$1.10x10^{-2}$	$6.00x10^{-3}$	$5.61x10^{-7}$	0.020 or 2%
TCE (child)	GW	ingestion	0.27	$1.39x10^{-3}$	$1.62x10^{-2}$	$1.10x10^{-2}$	$6.00x10^{-3}$	$1.53x10^{-5}$	2.70 or 270%
			0.0609*	$3.13x10^{-4}$	$3.66x10^{-3}$	$1.10x10^{-2}$	$6.00x10^{-3}$	$3.45x10^{-6}$	0.61 or 61%
		inhalation	0.27	$8.34x10^{-5}$	$9.73x10^{-4}$	$6.00x10^{-3}$	N/D	$5.00x10^{-7}$	N/A
		dermal	0.27	$3.23x10^{-5}$	$3.77x10^{-4}$	$1.10x10^{-2}$	$6.00x10^{-3}$	$3.55x10^{-7}$	0.063 or 6%
	SW	dermal	0.27	$2.02x10^{-5}$	$2.36x10^{-4}$	$1.10x10^{-2}$	$6.00x10^{-3}$	$2.23x10^{-7}$	0.039 or 4%
1,1,2,2 PCA (adult)	GW	ingestion	0.011	$1.29x10^{-4}$	$3.01x10^{-4}$	$2.00x10^{-1}$	N/D	$2.58x10^{-5}$	N/A
		inhalation	0.011	$3.88x10^{-6}$	$9.06x10^{-6}$	$2.03x10^{-1}$	N/D	$7.88x10^{-7}$	N/A
		dermal	0.011	$2.26x10^{-6}$	$5.26x10^{-6}$	$2.00x10^{-1}$	N/D	$4.51x10^{-7}$	N/A
	SW	dermal	0.012	$1.64x10^{-6}$	$3.83x10^{-6}$	$2.00x10^{-1}$	N/D	$3.28x10^{-7}$	N/A
1,1,2,2 PCA (child)	GW	ingestion	0.011	$5.65x10^{-5}$	$6.59x10^{-4}$	$2.00x10^{-1}$	N/D	$1.13x10^{-5}$	N/A
		inhalation	0.011	$3.40x10^{-6}$	$3.96x10^{-5}$	$2.03x10^{-1}$	N/D	$6.90x10^{-7}$	N/A
		dermal	0.011	$7.40x10^{-7}$	$8.64x10^{-6}$	$2.00x10^{-1}$	N/D	$1.48x10^{-7}$	N/A
	SW	dermal	0.012	$6.51x10^{-7}$	$7.59x10^{-6}$	$2.00x10^{-1}$	N/D	$1.30x10^{-7}$	N/A
Cd (adult)	GW	ingestion	0.014	$1.64x10^{-4}$	$3.84x10^{-4}$	N/D	$5.00x10^{-4}$	N/A	0.77 or 77%
			0.011*	$1.29x10^{-4}$	$3.01x10^{-4}$	N/D	$5.00x10^{-4}$	N/A	0.60 or 60%
Cd (child)	GW	ingestion	0.014	$7.19x10^{-5}$	$8.39x10^{-4}$	N/D	$5.00x10^{-4}$	N/A	1.68 or 168%
			0.011*	$5.65x10^{-5}$	$6.59x10^{-4}$	N/D	$5.00x10^{-4}$	N/A	1.32 or 132%

TABLE 6-2 (CONT.)

ADELPHI LABORATORY CENTER
BLDG. 500 REMEDIAL INVESTIGATION
CUMULATIVE SUMMARY TABLE FOR SITE COC

				LADE					
COC	Media	Pathway	Concentration mg/l or mg/kg	Carcinogenic mg/kg-day	Non-Carcinogenic mg/kg-day	CPS kg-day/mg	RfD mg/kg/day	Excess Cancer Cases	Hazard Quotient
RDX (adult)	GW	ingestion	0.007	8.22×10^{-5}	1.92×10^{-4}	1.10×10^{-1}	3.00×10^{-3}	9.04×10^{-6}	0.064 or 6%
RDX (child)	GW	ingestion	0.007	3.60×10^{-5}	4.20×10^{-4}	1.10×10^{-1}	3.00×10^{-3}	3.96×10^{-6}	0.14 or 14%
BaP (adult)	Sed	ingestion	1.0	5.87×10^{-7}	1.37×10^{-6}	7.3	N/D	4.29×10^{-6}	N/A
		dermal	1.0	2.53×10^{-6}	5.90×10^{-6}	7.3	N/D	1.85×10^{-5}	N/A
BaP (child)	Sed	ingestion	1.0	1.03×10^{-6}	1.20×10^{-5}	7.3	N/D	7.52×10^{-6}	N/A
		dermal	1.0	1.00×10^{-6}	1.17×10^{-5}	7.3	N/D	7.30×10^{-6}	N/A

NOTES:

COC = Contaminants of Concern
GW = Groundwater
Sed = Sediment
* = mean value of detections exceeding MCL
CPS = Cancer Potency Slope
RfD = Reference Dose
BaP = Benzo(a)pyrene
LADE = Lifetime Average Daily Exposure
TCE = Trichloroethene
Cd = Cadmium
RDX = hexahydro-1,3,5-trinitro-1,3,5-triazine
1,1,2,2 PCA = 1,1,2,2 tetrachloroethane

TABLE 7-1

ADELPHI LABORATORY CENTER
BLDG. 500 REMEDIAL INVESTIGATION
ANALYTICAL PARAMETERS FOR LONG-TERM MONITORING

	Chlorinated Solvents Method 8010	TPH-DRO	Explosives	Dissolved Cadmium
A-3	√		√	√
A-4	√	√	√	√
C-5	√		√	
C-6	√		√	
C-7	√		√	
C-8	√		√	
C-11	√	√	√	√
C-12	√			
C-14	√		*	
C-15	√		*	
[redacted]	√√	√√	√√	√√
[redacted]	√√	√√	√√	√√
SW-1	√		√	
SW-2	√		√	
SW-3	√		√	
SD-1	√		√	
SD-2	√		√	
SD-3	√		√	

Symbols used:

√	Sample to be analyzed for indicated parameters
*	Sample to be collected and analyzed for indicated parameters only if chlorinated solvents are *detected in C-14 or C-15 during prior sampling event.* Chorinated solvents are present in greater concentrations than explosives and would be expected to be seen at concentrations greater than MDL before explosives.
√√	Sampling of indicated parameters to be discontinued when residence connected to public water supply

APPENDICES

Appendix A

Boring Logs

TMA

Thomas, Moore & Associates, Inc.

129-6 West Patrick Street
Frederick, MD 21701
(301) 698-9788

Elevations for Existing Wells Casings Around Building 500 at the Naval Surface Weapons Center, Adelphi, Maryland

Thomas, Moore & Associates, Inc., of Frederick, MD, located the following wells on June 18 & 19, 1996. All top of casing elevations noted are to the top of the interior casing of the actual well, as determined by differential levels. Horizontal and vertical information noted hereon is based on a plan provided by the U. S. Army, Corp of Engineers entitled "U. S. Army Laboratory; Adelphi, Maryland; Adelphi Microwave Facility; Soil Boring Location Plan; Sheet C-1" as prepared by STV Architects of Pottstown, PA, and dated 10/29/93.

Well #	Northing	Easting	Top of casing Elevation	Ground Elevation
A-1	52962.6830	15384.0376	217.79	215.6
A-2	52639.8734	15193.2592	191.33	191.3
A-3	52588.9863	15501.0096	197.02	195.0
A-4	52408.3019	15368.5855	189.72	187.4
C-5	52916.8579	14777.4245	215.24	213.5
C-6	53176.0371	15224.1666	234.47	232.5
C-7	53072.3888	15530.6677	222.49	220.6
C-8	52934.7176	15653.7811	213.17	211.6
C-9	52775.6841	15178.1266	204.47	203.2
C-10	52516.7834	15042.3340	191.93	189.8
C-11	52399.3219	15385.9833	189.70	187.5
C-12	52120.3686	15102.6482	189.95	188.0
C-13	52706.5005	15429.7721	180.10	180.5

ADELPHI, MD.

ADELPHI LABORATORY CENTER - RI

SUBSURFACE EXPLORATION NOTES

1. EXPLORATION WAS PERFORMED DURING MAY-JUNE 1996.

2. BORINGS C-5 THRU 13 WERE ACCOMPLISHED BY STANDARD PENETRATION TEST PROCEDURE (SPT) USING A 1-3/8" ID X 2'-3/4" LONG SPLIT SPOON. SAMPLE SPOONS WERE ADVANCED BY A 140# HAMMER FALLING 30". THESE HOLES WERE POWER AUGERED BETWEEN SAMPLES UNLESS OTHERWISE INDICATED. BLOW COUNTS SHOWN ARE FOR 0.5' OF DRIVE UNLESS OTHERWISE INDICATED.

   BORINGS TB-2 THRU 4 WERE ACCOMPLISHED BY DRIVING A 3"ID SPLIT SPOON WITH A 300# HAMMER FALLING 30". HOLES WERE ADVANCED BETWEEN SAMPLES WITH A POWER AUGER UNLESS OTHERWISE INDICATED. BLOW COUNTS ARE FOR 0.5' OF DRIVE UNLESS OTHERWISE INDICATED.

   ROCK WAS CORED WITH AN HQ SERIES CORE BIT

   NR - INDICATES BLOW COUNTS NOT RECORDED

3. THE ROCK COLORS WITH LETTER/NUMBER DESIGNATION ARE IN ACCORDANCE WITH "ROCK COLOR CHART" DISTRIBUTED BY THE GEOLOGICAL SOCIETY OF AMERICA. THESE COLORS ARE GIVEN WHEN CORE IS WET.

4. BLOW COUNTS REQUIRED TO ADVANCE SAMPLE ARE SHOWN IN COLUMN (a), EXCEPT WHEN ROCK IS CORED, WHERE PERCENT CORE RECOVERY IS SHOWN.

5. COLUMN (b) SHOWS THE NATURAL WATER CONTENTS IN PER CENT OF DRY WEIGHT OF THOSE SAMPLES TESTED AND PERCENT RQD WHERE ROCK WAS CORED. RQD IS CALCULATED AS NQ SIZE CORE PIECES GREATER THAN OR EQUAL TO 4" PER RUN AS DRILLED.

6. SOIL DESCRIPTIONS ARE SHOWN IN COLUMN (c).

7. SOIL DESCRIPTIONS ARE LABORATORY CLASSIFICATIONS BASED ON THE UNIFIED SOIL CLASSIFICATION SYSTEM (ASTM D2487), EXCEPT THOSE INDICATED THUS (**), WHICH ARE FIELD INSPECTOR'S CLASSIFICATIONS.

ROCK CORE LOGGING ARE BASED ON GUIDELINES PROVIDED BY HQUSACE, AEG (S. AFRICA SECTION), AND SUPPLEMENTAL CRITERIA PROVIDED BY USACE - BALTIMORE DISTRICT.

8. GROUNDWATER DEPTHS ARE INDICATED ON THE LOGS AS $\underline{\nabla}$, $\underline{\nabla}$ & $\underline{\blacktriangledown}$ AND ARE SHOWN IN COLUMN (d). PERTINENT DATA FOR THESE READINGS ARE SHOWN AT THE BOTTOM OF LOG UNDER GROUNDWATER DATA OR ADDITIONAL GROUNDWATER DATA. ACTUAL GROUNDWATER LEVEL MAY VARY DEPENDING UPON SEASONS AND AMOUNT OF RAINFALL.

9. ELEVATIONS SHOWN ON THE BORING LOGS ARE GROUND SURFACE ELEVATIONS AT THE TIME OF EXPLORATION. THEY WERE DETERMINED BY SURVEY.

10. FOR LOCATIONS OF SUBSURFACE EXPLORATIONS SEE FIGURE 2-1.

11. MATERIALS CLASSIFIED AS DECOMPOSED ROCK ON THE BORING LOGS ARE RESIDUAL MATERIALS WITH A STANDARD PENETRATION TEST RESISTANCE OF BETWEEN 60 BLOWS PER FOOT AND REFUSAL. REFUSAL IS DEFINED AS A STANDARD PENETRATION RESISTANCE OF 100 BLOWS OVER 2" OR LESS PENETRATION.

STA.
OFFSET:
TOP ELEV: 213.5

ADELPHI LABORATORY CENTER - RI
ADELPHI, MD.

N 52916.9
E 14777.4
COMPLETED: May 30, 1996

Depth	(c)	(d)	Scale	(a)	(b)
0.2	Moist lt. brn. & brn. sandy(fine) lean CLAY w/ tr. roots (CL)				
2.0	Moist red sandy(fine) lean CLAY (CL)			1-3-3	
4.5	Sli. moist yellow red silty SAND w/ gravel (SM)			15-42-32	
7.0	Sli. moist reddish yellow clayey SAND w/ tr. gravel(broken) (SC)		5	30-34-21	
9.5	Moist yellow red sandy lean CLAY w/ tr. gravel (CL)			9-10-14	
13.3	Dry reddish yellow & white clayey SAND w/ gravel(broken) (SC)		10	41-62-75	
18.3	Moist lt. brown gray clayey SAND (SC)		15	10-14-15	
	Moist reddish yellow clayey SAND w/ gravel (SC)				

C-5
GROUNDWATER DATA
▽ WHILE DRILLING: 20.56
▼ ON COMPLETION: 21.7
▼ 24 Hr. READING: 20.1

Fill | Auger | SPT | RB | Cored

TOP ELEV: 213.5 COMPLETED: May 30, 1996

Elev.	(c)	(d)	Depth	(a)	(b)
	Moist reddish yellow clayey SAND w/ gravel (SC)			10-13-15	13.7
	20.0'-21.5' L.O.I. = 0.8% - Inorganic				
23.3	Wet very pale brown poorly graded GRAVEL w/ silt & sand(coarse-fine) (GP-GM)		25	10-10-18	
28.3	Wet yellow brown poorly graded GRAVEL w/ silt & sand(coarse-fine) (GP-GM)				
	30.0'-31.5' L.O.I. = 1.0% - Inorganic		30	21-28-25	10.9
33.3	DECOMPOSED ROCK, dry, yellowish brown		35	25-75-72	
36.5	BOTTOM OF HOLE				
	AN OBSERVATION WELL WAS INSTALLED IN THIS HOLE Top of screen: 16.0' Bottom of screen: 36.0'				
	ADDITIONAL GROUNDWATER DATA: 24 Hr. reading shown was taken after well was installed.		40		

Fill Auger SPT RB Cored

GEO-2 AD001 9/5/96 10:23

STA.	ADELPHI LABORATORY CENTER - RI	N 53176.0	**C-6**
OFFSET:	ADELPHI, MD.	E 15224.2	
TOP ELEV: 232.5		COMPLETED: May 24, 1996	

Depth	(c)	(d)	Scale	(a)	(b)
	A mixture of sli. moist dk. gray brn. SILT, SAND, GRASS & ROOTS w/ mica			4-6-5	
2.0	Moist yellow red sandy lean CLAY w/ mica & tr. gravel (CL)			9-15-22	
4.5	Moist reddish yellow clayey SAND w/ gravel (SC)		5	7-10-7	
7.0	Moist reddish yellow silty clayey SAND (SC-SM)			6-10-12	
9.5	Moist reddish yellow clayey GRAVEL w/ sand & mica (GC) 10.0'-11.5' L.O.I. = 1.9% - Inorganic	∇	10	10-31-50	6.8
13.3	Very moist yellowish red sandy lean CLAY w/ tr. gravel & roots (CL)	▼ ▼	15	41-36-28	
18.3	Moist reddish yellow clayey GRAVEL w/ sand (GC)				

C-6
GROUNDWATER DATA
∇ WHILE DRILLING: 12.5
▼ ON COMPLETION: 15.8
▼ 16 Hr. READING: 15.2

Fill | Auger | SPT | RB | Cored

GEO:2 AD001 9/5/96 10:24

Depth	(c)	(d)	Scale	(a)	(b)
	Moist reddish yellow clayey GRAVEL w/ sand (GC)			17-27-20	
23.3	Very moist yellowish red clayey SAND w/ gravel (SC)				
	25.0'-26.5' L.O.I. = 2.1% - Inorganic		25	19-24-23	12.4
28.3	Moist lt. red & reddish yellow silty clayey SAND w/ mica, tr. weathered rock fragments (SC-SM)		30	8-14-19	
31.5	BOTTOM OF HOLE				

AN OBSERVATION WELL WAS INSTALLED IN THIS HOLE
Top of screen: 9.1'
Bottom of screen: 29.1'

ADDITIONAL GROUNDWATER DATA:
5/24/96: 10.8'(after well was installed)

ENVIRONMENTAL MONITORING:
A PID was used to monitor boring. No measurements above action levels were recorded.

35

40

Fill Auger SPT RB Cored

STA.	ADELPHI LABORATORY CENTER - RI	N 53072.4	**C-7**
OFFSET:	ADELPHI, MD.	E 15530.7	
TOP ELEV: 220.6		COMPLETED: June 5, 1996	

Depth	(c)	(d)	Scale	(a)	(b)
0.2	Sli. moist dk. yell. brn. sandy(fine) lean CLAY w/ tr. roots (CL)			2-3-4	
2.0	Moist red & yellow red sandy lean CLAY w/ tr. gravel & roots (CL)				
4.5	Moist red sandy lean CLAY w/ tr. gravel (CL)			3-9-13	
7.0	Sli. moist pink & yellowish red silty clayey SAND (SC-SM)	⊻	5	17-18-12	
9.5	Very moist very pale brown silty GRAVEL w/ sand (GM)	⊻		12-24-26	
13.3	Very moist yellow clayey GRAVEL w/ sand (GC)		10	6-12-11	
18.3	A mixture of wet brownish yellow SILT, SAND & GRAVEL (Sample recovery too small to classify)		15	10-20-17	
	Wet very pale brown clayey SAND w/ gravel (SC)				

C-7
GROUNDWATER DATA
⊻ WHILE DRILLING: 6.0
⊻ ON COMPLETION: 7.45
⊻ 24 Hr. READING: NT

Fill | Auger | SPT | RB | Cored

GEO-2 AD001 9/5/96 10:24

	(c)	(d)		(a)	(b)
23.5	Wet very pale brown clayey SAND w/ gravel (SC) 20.0'-21.5' L.O.I. = 0.6% - Inorganic			10-12-14	15.3
				73-33-100/.45	
	BOTTOM OF HOLE		25		
	AN OBSERVATION WELL WAS INSTALLED IN THIS HOLE Top of screen: 2.8' Bottom of screen: 22.8'				
			30		
	ADDITIONAL GROUNDWATER DATA: Completion reading shown (7.45') was taken before well installation. 6/5/96: @ 0730: 5.52' (before well installation)				
			35		
			40		

Fill Auger SPT RB Cored

STA.
OFFSET:
TOP ELEV: 211.6

ADELPHI LABORATORY CENTER - RI
ADELPHI, MD.

N 52934.7
E 15653.8
COMPLETED: June 6, 1996

C-8

Depth	(c)	(d)
0.2	Moist brn. to v. dk. brn. silty SAND w/ tr. roots & stems (SM)	
2.0	Moist reddish yellow lean CLAY w/ sand & tr. roots (CL)	
3.3	Moist reddish yellow sandy lean CLAY (CL)	
4.5	Dry reddish yellow silty SAND w/ gravel (SM)	
7.0	Sli. moist pink white silty SAND(fine) w/ tr. gravel (SM)	∇
9.5	Moist pink white sandy(fine) SILT w/ tr. gravel (ML)	
11.2	Moist pink white & reddish yellow silty SAND(med.- fine) (SM)	
13.3	Moist brown yellow clayey SAND(coarse-fine) w/ gravel (SC)	▼
18.3	Very moist lt. brown clayey GRAVEL(ROCK FRAGMENTS) w/ sand (GC) 15.0'-16.5' L.O.I. = 0.2% - Inorganic	
21.5	Moist lt. brown silty GRAVEL w/ sand & tr. mica (GM)	
22.9	Very moist lt. brown yellow clayey GRAVEL w/ sand & tr. mica (GC)	

Depth scale	(a)	(b)
0–1.5	1-3-3	
2.5–4	29-16-17	
5–6.5	15-12-13	
7.5–9	7-15-17	
10–11.5	12-15-41	
15–16.5	76-60-58	7.0
20	41-100/.45	
22	66-100/.4	

Depth scale: 5, 10, 15, 20, 25, 30, 35

BOTTOM OF HOLE

AN OBSERVATION WELL WAS INSTALLED IN THIS HOLE
Top of screen: 1.1'
Bottom of screen: 21.1'

ADDITIONAL GROUNDWATER DATA:
6/4/96 @ 1350: 6.8' (before well installation)
6/5/96 @ 0730: 6.7'(before well installation)

C-8
GROUNDWATER DATA
∇ WHILE DRILLING: 7.05
▼ ON COMPLETION: 12.5
▼ 24 Hr. READING: NT

Fill Auger SPT RB Cored

STA. ADELPHI LABORATORY CENTER - RI N 52775.7 **C-9**
OFFSET: ADELPHI, MD. E 15178.1
TOP ELEV: 203.1 COMPLETED: May 20, 1996

Depth	(c)	(d)	Depth (ft)	(a)	(b)
0.7	Moist brown silty SAND(fine) w/ tr. roots & grass (SM)			1-2-5	
2.0	Moist lt. yellow brown silty SAND w/ gravel (SM)				
	Moist pale yellow clayey GRAVEL w/ sand & mica (GC)			4-6-8	
			5		
				NR	
		▼	10		
	12.5'-14.0' L.O.I. = 0.4% - Inorganic			17-20-58	
14.8	Moist brownish yellow clayey SAND w/ gravel & mica (SC)		15		
				15-28-28	
18.5	Sli. moist reddish yellow & very pale brown clayey SAND (SC) w/ mica				
			20		
21.5				10-11-12	

BOTTOM OF HOLE

AN OBSERVATION WELL WAS INSTALLED IN THIS HOLE
Top of screen: 4.5'
Bottom of screen: 24.5'

ADDITIONAL GROUNDWATER DATA:
5/20/96 @ 0930: 9.2' (during well installation)
5/21/96: 9.55' (at completion of well)

NR - INDICATES BLOW COUNTS NOT RECORDED

C-9
GROUNDWATER DATA
▽ WHILE DRILLING: NE
▼ ON COMPLETION: 9.2
▼ 24 Hr. READING: NT

Fill Auger SPT RB Cored

STA.
OFFSET:
TOP ELEV: 189.8

ADELPHI LABORATORY CENTER - RI
ADELPHI, MD.

N 52516.8
E 15042.3
COMPLETED: May 15, 1996

C-10

Depth	(c) Description	Depth scale	(a)	(b)
0.6	Moist brn. sandy lean CLAY w/ mica, tr. rock, roots & grass (CL)		3-6-9	
2.0	Moist lt. gray & lt. brown sandy lean CLAY w/ gravel (CL)			
4.5	Moist lt. brown gray & brown yellow sandy lean CLAY w/ tr. gravel (CL)		12-8-9	
7.0	A mixture of moist lt. brown gray & brown yellow CLAY, SAND & GRAVEL	5	7-7-5	
13.3	Moist yellowish brown silty SAND (SM) w/ mica	10	7-9-10; 9-10-17	
24.4	DECOMPOSED ROCK, moist, yellowish brown & black 15.0'-16.5' L.O.I. = 3.5% - Inorganic	15, 20	47-40-51; 24-27-37; 32-67-100/.4	12.2

BOTTOM OF HOLE

AN OBSERVATION WELL WAS INSTALLED IN THIS HOLE
Top of screen: 4.9'
Bottom of screen: 24.9'

ADDITIONAL GROUNDWATER DATA:
5/15/96 @ 1245: 7.8' (before well completion)
5/15/96: 4.1' (on completion of well)
5/16/96 @ 0900: 24 Hr. reading shown (4.3') was taken after well was installed.

25
30
35

C-10
GROUNDWATER DATA
WHILE DRILLING: 20.0
ON COMPLETION: NT
24 Hr. READING: 4.3

Fill Auger SPT RB Cored

GEO-2 AD001 9/5/96 10:43

STA. ADELPHI LABORATORY CENTER - RI N 52399.3 **C-11**

OFFSET: ADELPHI, MD. E 15386.0

TOP ELEV: 187.5 COMPLETED: May 17, 1996

Depth	(c)	(d)	Elev.	(a)	(b)
0.2	Moist dk. redd. brn. sandy(fine) SILT w/ roots & twigs (ML)			1-2-2	
2.0	Moist yellow brown SILT w/ sand, tr. roots & leaves (ML)				
4.2	Dry yellowish brown clayey SAND w/ rock fragments (SC)			58-100/.4	
9.5	Sli. moist yellowish brown clayey SAND w/ gravel(broken) (SC)		5	56-100/.3	
				11-19-18	
13.3	DECOMPOSED ROCK, dry, brown		10	33-32-30	
18.2	Silty SAND (SM), w/ mica, moist, brown & yellow		15	10-18-29	
25.3	DECOMPOSED ROCK, dry, yellowish brown Greenish gray below 23.2'	▼ (18.5) ▽ (20.0)	20	30-67-100/.3	
			25	100/.3	
	TOP OF ROCK @ 25.3'	▼ (26.3)		0	0
	GNEISS: dk. greenish gray(5GY 4/1) - greenish black(5GY 2/1) & speckled medium dk. gray(N4) & olive gray(5Y 4/1) or med. lt. gray(N6) and grayish black (N2), med. soft-hard, mod. weathered-unweathered, med.-coarse grained 26.1-26.3': lt. brownish gray(5YR 6/1) quartzite 28.3-32.1': med. soft-hard, sli.-mod. weathered 32.1-47.6': med. soft-hard, sli. weathered-unweathered 47.6-48.5': soft, clay filled fractures 48.5-74.8': hard, unweathered			9	
			30	95	44
				100	70
	STRUCTURE: 28.4-29.5': flat-gentle dip, close, sli. rough, narrow , occ. yell. green fill 30.6-32.1':flat-gentle dip, close, sli. rough, narrow, mod. olive brn. fill 33.2': v. steep dip, smooth-sli. rough, grayish olive gray fill		35	100	100

C-11

GROUNDWATER DATA

▽ WHILE DRILLING: 20.0

▼ ON COMPLETION: 18.5

▼ 24 Hr. READING: 26.3

Fill | Auger | SPT | RB | Cored

GEO-2 AD001 9/5/96 10:46

	(c)	(d)	(a)	(b)
	33.5': gentle dip, smooth-sli. rough, narrow, clean 34.2': mod. dip, smooth, v. narrow-narrow, dk . grayish brn. stain 34.4': mod. dip, smooth, v. narrow-narrow, dk. orange brn. stain 34.6': mod. dip, sli. rough, narrow, olive black fill 37.8': mod. dip, sli. rough, narrow-wide, clean		100	87
	40.1': mod. dip, smooth, narrow-wide, olive brn.- grayish olive fill 40.4': mod. dip, smooth, narrow-wide, mod. olive brn-grayish olive fill 41.3': v. steep dip, smooth, wide, dusky yellow fill 41.7': mod. dip, smooth, v. narrow-narrow, dusky yellow fill 42.0': mod. dip, smooth, v. narrow, lt. olive brn. fill	45	100	80
	42.2': gentle dip, sli. rough, v. narrow, clean 43.9-44.4': mod. steep dip, close, sli. rough, narrow, mod. olive brn. fill 47.4-48.5': flat-gentle dip, close-v. close, smooth, narrow-wide, lt. olive gray clay fill 49.8': gentle-mod. dip, smooth-sli. rough, v. narrow, dusky yell. fill	50	94	90
	50.5': mod. dip, smooth, v. narrow-narrow, olive gray stain/fill 54.8': gentle dip, sli. rough, tight-v. narrow, clean, poss. mech. break 55.8': gentle dip, sli. rough, v. narrow, clean, poss. mech. break 56.6': flat dip, sli. rough, v. narrow, clean, poss. mech. break	55	106	100
	57.3': flat dip, sli. rough, v. narrow, clean, poss. mech. break 58.5': gentle dip, sli. rough, v. narrow, clean, poss. mech. break 60.4': steep dip, sli. rough, narrow wide, pale olive-yell. gray fill 61.3': flat dip, smooth, narrow, tr. orange brown stain 62.0': flat dip, sli. rough, narrow, clean, poss. mech. break 62.9': flat dip, sli. rough, narrow, clean, poss. mech. break 63.4': gentle dip, smooth, narrow, lt. olive gray fill	60	100	100
	65.8': mod. dip, sli. rough, v. narrow-narrow, clean, poss. mech. break 68.3': flat dip, sli. rough, narrow-wide, clean, poss. mech. break 68.4': mod. dip, smooth-sli. rough, narrow-wide, clean 71.6': mechanical break fitting core into core box 73.5': mechanical break fitting core into core box 74.5': mechanical break fitting core into core box 73.1'-74.7': v. steep dip, smooth, wide, lt. olive gray fill	65	100	100
74.9		70	98	86
	BOTTOM OF HOLE	75		

AN OBSERVATION WELL WAS INSTALLED IN THIS HOLE
Top of screen: 64.6'
Bottom of screen: 74.6'

ENVIRONMENTAL MONITORING:
A PID was used to monitor boring. No measurements above action levels were recorded.

NOTE: Drill water was introduced into boring at 25.3'.

80

Fill Auger SPT RB Cored

STA. | ADELPHI LABORATORY CENTER - RI | N 52120.4 | **C-12**

OFFSET: | ADELPHI, MD. | E 15102.6 |

TOP ELEV: 188.0 | COMPLETED: May 15, 1996

Depth	(c)	(d)	Scale	(a)	(b)
2.0	Sli. moist yell. brn. sandy lean CLAY w/ tr. gravel & roots (CL)			5-7-11	
4.5	Sli. moist reddish brown sandy elastic SILT (MH)			8-16-28	
7.0	DECOMPOSED ROCK, moist, yellowish red		5	31-35-37	
9.5	Sli. moist yellowish brown silty SAND w/ mica & tr. weathered rock fragments (SM)			16-10-11	
12.0	Sli. moist yellowish brown silty SAND (SM) w/ mica		10	9-23-27	
20.5	DECOMPOSED ROCK, dry, yellow brown	⊻	15	22-30-54	
			20	100/.35	
32.9	TOP OF ROCK @ 20.5' GNEISS, extremely weathered to sli. weathered , medium dk. gray (N4), Quartz grains, micaceous, iron staining in areas (20.5'-22.2') 20.5'-24.9': highly weathered 25.0'-28.9': highly weathered 29.9'-32.9': Slightly weathered STRUCTURE: 20.5'-25.8': all broken up 27.1': flat dip, medium rough, v. wide, stained 27.8': flat dip over most of fracture, rough, wide, clean 28.4': mechanical break 28.9': same as 27.8' 32.3': near vert. shear, sli. rough, wide, rel. clean 32.9': same as 27.8'		25 30	85 96 80 113	
	BOTTOM OF HOLE NOTE: Drillwater was introduced into hole at 20.5' AN OBSERVATION WELL WAS INSTALLED IN THIS HOLE Top of screen: 5.3' Bottom of screen: 25.3'		35		

C-12
GROUNDWATER DATA
⊻ WHILE DRILLING: 17.0
⊻ ON COMPLETION: NT
⊻ 24 Hr. READING: NT

Fill | Auger | SPT | RB | Cored

GEO-2 AD001 9/5/96 10:30

TOP ELEV: 188.0 COMPLETED: May 15, 1996

(c) (d) (a) (b)

ADDITIONAL GROUNDWATER DATA:
5/15/96 Encountered reading shown (7:30 17.0') was before coring rock.
5/15/96 @ 0730: 10.2' (before coring rock)
5/22/96: 10.3' (before well installation)

45
50
55
60
65
70
75
80

Fill Auger SPT RB Cored

STA.
OFFSET:
TOP ELEV: 180.1

ADELPHI LABORATORY CENTER - RI
ADELPHI, MD.

N 52706.5
E 15429.8
COMPLETED: June 22, 1996

C-13

Depth	(c)	(d)	Depth scale	(a)	(b)
0.9	CONCRETE (**)				
3.7	Dry to sli. moist green/tan fine grained micaceous SAND w/ some gravel (**)			3-3-13	
10.3	Dry gray DISINTEGRATED ROCK, w/ mica (**)		5	100/.4	
			10	100/.25	
	BOTTOM OF HOLE				

AN OBSERVATION WELL WAS INSTALLED IN THIS HOLE
Top of screen: 1.0'
Bottom of screen: 11.0'

ADDITIONAL GROUNDWATER DATA
6/24/96 @ 0825: 3.0'(after well was installed)

15 20 25 30 35

C-13
GROUNDWATER DATA
WHILE DRILLING: NE
ON COMPLETION: NE
24 Hr. READING: NT

Fill | Auger | SPT | RB | Cored

GEO-2 AD001 9/5/96 10:31

STA. ADELPHI LABORATORY CENTER - RI N **TB-2**

OFFSET: ADELPHI, MD. E

TOP ELEV: COMPLETED: May 29, 1996

Depth	(c)	(d)	Scale	(a)	(b)
0.5	CONCRETE (**)				
2.0	Sli. moist lt. brn. gray clayey SAND w/ rock fragments (SC)			9-18-20	
4.0	Sli. moist brown yellow clayey GRAVEL(coarse) w/ sand (GC)			20-15-13-23	
6.0	Moist reddish yellow poorly graded GRAVEL(coarse) w/ clay & sand (GP-GC)	▼	5	13-15-13-14	
8.0	Sli. moist reddish yellow poorly graded GRAVEL(coarse) w/ clay & sand (GP-GC)	▽		16-21-31-28	
10.0	Wet reddish yellow poorly graded GRAVEL(coarse) w/ clay & sand (GP-GC)			23-24-31-32	
	BOTTOM OF HOLE		10		

ADDITIONAL GROUNDWATER DATA
5/29/96 @ 0915: 6.78'(while drilling)

15

20

25

30

35

TB-2
GROUNDWATER DATA
▽ WHILE DRILLING: 7.85
▼ ON COMPLETION: 5.72
▼ 24 Hr. READING: NT

Fill Auger SPT RB Cored

GEO-2 AD001 9/5/96 10:31

STA.
OFFSET:
TOP ELEV:

ADELPHI LABORATORY CENTER - RI
ADELPHI, MD.

N
E
COMPLETED: May 17, 1996

Depth	(c)	(d)	Scale	(a)	(b)
0.2	ASPHALT (**)				
1.1	Dry greenish gray medium sandy SILT w/ fine-coarse gneiss gravel (**)			3/.4-8	
2.0	Sli. moist lt. gray clayey GRAVEL w/ sand (GC)			10-19-15-15	
4.0	Moist lt. gray & yellow red clayey SAND w/ gravel (SC)				
6.0	Sli. moist green gray clayey GRAVEL w/ sand (GC)	▼	5	4-7-14-15	
8.0	Very moist reddish yellow poorly graded GRAVEL w/ silt (GP-GM)	∇		5-9-8-7	
10.0	Moist yellowish brown black & brown yellow silty SAND w/ rock fragments and mica (SM)			7-5-6-7	
	BOTTOM OF HOLE		10		

ENVIRONMENTAL MONITORING:
A PID was used to monitor boring. No measurements above action levels except when monitoring soil samples from 1.6' where a reading of 8.6ppm was observed. Environmental samples were taken around this depth.

15
20
25
30
35

TB-3
GROUNDWATER DATA
∇ WHILE DRILLING: 6.57
▼ ON COMPLETION: 4.62
▼ 24 Hr. READING: NT

Fill Auger SPT RB Cored

GEO-2 AD001 9/5/96 10:32

TOP ELEV: COMPLETED: May 16, 1996

Depth	(c)	(d)	(a)	(b)
0.2	Moist brown sandy lean CLAY w/ tr. gravel & w/ roots & grass (CL)		5-16-20-8	
2.0	Slightly moist reddish yellow silty clayey SAND (SC-SM)		6-7-8-11	
8.0	Slightly moist reddish yellow clayey SAND (SC)		3-4-7-10 5-7-8-7	
8.9	Moist reddish yellow sandy fat CLAY (CH)		5-4-6-19	
10.0	Moist lt. gray & reddish yellow lean CLAY w/ sand (CL)			
12.0	Moist lt. brown clayey SAND (SC)		10-11-10-12	
14.0	Moist brown yellow poorly graded GRAVEL w/ sand & mica (GP-GM)	▼	9-26-30-24	
16.0	Wet brown yellow poorly graded SAND w/ gravel & mica (SP-SM)		8-8-13-18	

Depth scale: 5, 10, 15, 20, 25, 30, 35

BOTTOM OF HOLE

ENVIRONMENTAL MONITORING:
A PID was used to monitor boring. No measurements above action levels except when monitoring soil samples from 5.7' where a reading of 2.4ppm was observed. Environmental samples were taken from the interval 5.2'-6.5'.

TB-4
GROUNDWATER DATA
▽ WHILE DRILLING: 13.09
▼ ON COMPLETION: 13.05
▼ 24 Hr. READING: 13.45

Fill Auger SPT RB Cored

GEO-2 AD001 9/5/96 10:32

ADELPHI, MD.

REMEDIAL INVESTIGATION @ BUILDING 500

SUBSURFACE EXPLORATION NOTES

1. EXPLORATION WAS PERFORMED DURING APRIL 1997.

2. COMPLETE DRILLING PROCEDURE IS SHOWN ON EACH BORING LOG. SAMPLING WAS ACCOMPLISHED BY STANDARD PENETRATION TEST PROCEDURE (SPT) USING A 1-3/8" ID X 2'-8" LONG SPLIT SPOON. SAMPLE SPOONS WERE ADVANCED BY A 140# HAMMER FALLING 30". THESE HOLES WERE POWER AUGERED BETWEEN SAMPLES UNLESS OTHERWISE INDICATED. BLOW COUNTS SHOWN ARE FOR 0.5' OF DRIVE UNLESS OTHERWISE INDICATED.

   ROCK WAS CORED WITH AN HQ SERIES CORE BIT.

   TR - TOP OF WEATHERED ROCK

   RB - HOLE WAS ADVANCED BY ROCK BIT

3. THE ROCK COLORS WITH LETTER/NUMBER DESIGNATION ARE IN ACCORDANCE WITH "ROCK COLOR CHART" DISTRIBUTED BY THE GEOLOGICAL SOCIETY OF AMERICA. THESE COLORS ARE GIVEN WHEN CORE IS WET.

4. BLOW COUNTS REQUIRED TO ADVANCE SAMPLE ARE SHOWN IN COLUMN (a), EXCEPT WHEN ROCK IS CORED, AT WHICH TIME PERCENT CORE RECOVERY IS SHOWN.

5. COLUMN (b) SHOWS THE NATURAL WATER CONTENTS IN PER CENT OF DRY WEIGHT OF THOSE SAMPLES TESTED AND PERCENT RQD WHERE ROCK WAS CORED. RQD IS CALCULATED AS NQ OR HQ SIZE CORE PIECES GREATER THAN OR EQUAL TO 4" PER RUN AS DRILLED.

6. SOIL DESCRIPTIONS ARE SHOWN IN COLUMN (c).

7. SOIL DESCRIPTIONS ARE LABORATORY CLASSIFICATIONS BASED ON THE UNIFIED SOIL CLASSIFICATION SYSTEM (ASTM D2487), EXCEPT THOSE INDICATED THUS (**), WHICH ARE FIELD INSPECTOR'S CLASSIFICATIONS.

THE ORGANIC TEST (ASTM D2974, METHOD "C"; OR LOSS ON IGNITION TEST (LOI) (ASSHTO-T-267) WAS USED TO EVALUATE AND DESCRIBE THE ORGANIC CONTENT OF SOILS FOR DESIGN AND CONSTRUCTION AS FOLLOWS:

LOI	SOIL DESCRIPTION
<12	INORGANIC
12 TO 24	ORGANIC
25 TO 60	VERY ORGANIC
>60	PEAT (Pt)

ROCK CORE LOGGING ARE BASED ON GUIDELINES PROVIDED BY HQUSACE, AEG (S. AFRICA SECTION), AND SUPPLEMENTAL CRITERIA PROVIDED BY USACE - BALTIMORE DISTRICT.

8. BORINGS C-14 & C-15 WERE MONITORED WITH A COMBUSTIBLE GAS INDICATOR (CGI) WITH OXYGEN METER, AND EACH SAMPLE WAS SCREENED WITH A Hnu METER. UNLESS OTHERWISE INDICATED, NO MEASUREABLE READINGS ABOVE ACTION LEVELS WERE OBTAINED IN THE FIELD.

9. GROUNDWATER DEPTHS ARE INDICATED ON THE LOGS AS ∇ , $\blacktriangledown$ & $\blacktriangledown$ AND ARE SHOWN IN COLUMN (d). PERTINENT DATA FOR THESE READINGS ARE SHOWN AT THE BOTTOM OF LOG UNDER GROUNDWATER DATA OR ADDITIONAL GROUNDWATER DATA. ACTUAL GROUNDWATER LEVEL MAY VARY DEPENDING UPON SEASONS AND AMOUNT OF RAINFALL.

10. ELEVATIONS SHOWN ON THE BORING LOGS ARE GROUND SURFACE ELEVATIONS AT THE TIME OF EXPLORATION. THEY WERE DETERMINED BY SURVEY.

11. FOR LOCATIONS OF SUBSURFACE EXPLORATIONS SEE BORING LOCATION PLAN.

STA. | RI INVESTIGATION @ BUILDING 500 | N 53171.9 | C-14
OFFSET: | ADELPHI, MD. | E 15231.1 | 1 of 7
TOP ELEV: 232.3 | | COMPLETED: April 21, 1997

(c) (d) (a) (b)

5

NOT SAMPLED
(SEE LOG FOR C-6)

10

C-14
GROUNDWATER DATA
WHILE DRILLING: 17.0
ON COMPLETION: NT
24 Hr. READING: 47.3

Fill Auger SPT RB Cored

GEO-2 AD003 7/11/97 09:38

(c) (d) (a) (b)

20

NOT SAMPLED

25

30

Fill Auger SPT RB Cored

Depth	(c)	(d)		(a)	(b)
	NOT SAMPLED				
35.0	Moist lt. green, gray & olive yellow micaceous clayey SAND w/ tr. rock (SC) [SAPROLITE]		35	17-38-41	20.8
38.3	Sli. moist lt. olive gray & black micaceous clayey SAND (SC) [SAPROLITE]		40	28-47-101/.07	11.7
	45.0'-45.65': L.O.I = 2.3% - Inorganic		45	64-100/.15	12.1
47.8	Dry pale yellow, olive & black micaceous clayey SAND (SC) [SAPROLITE]				

Fill Auger SPT RB Cored

Elev.	Description (c)	Depth (d)	(a)	(b)
	Dry pale yellow, olive & black micaceous clayey SAND (SC) [SAPROLITE]	50		
50.7	TOP OF ROCK		72-100/.17	9.3
	GNEISS, mod. weathered, soft, fine to medium grained, muscovite, biotite, quartz and feldspar minerals present, colors are white, oloive green, black, off white to pale yellow, silver and lt. gray. Core is randomly streaked with 1mm thin white veins		87	87
		55	0	
	57.0' GNEISS, mod. weathered, soft, fine to med. grained, colors are pale yellow, greenish white, olive green, lt. gray, silver		66	24
59.8	Med. to coarse grained, rough texture			
	QUARTZITE, sli. weathered to unweathered, olive green, lt. gray, pale yellow, greenish gray, fine to med. grain, smooth texture, hard, highly fractured, tr. of muscovite, biotite materials	60	100	20
			100	0
	63.2' Olive green, grayish green, lt. gray, hard, very fine grain, smooth texture, fracture planes are steeply dipping.		100	23
	65.0' Dk. gray & greenish gray, med. soft-soft, mod. weathered	65		
	STRUCTURE:			

Fill Auger SPT RB Cored

(c)	(d)	(a)	(b)
65.0'-65.5': rubble 65.7': 48 deg., close, smooth-sli. rough, wide-v. wide, mod. yell.- dusky yellow clay fill 66.1': 44 deg., close, smooth, wide, mod. yell.-dusky yellow stain 66.5' flat, narrow-v. narrow, possible mechanical break		100	58
68.0' Dk. gray-grayish black and some pale olive, med. soft-hard, sli. weathered STRUCTURE: 66.9': mechanical break 67.2': mechanical break 67.9': 54 deg., close, smooth, narrow, tr, pale olive fill 68.2': hammer break 68.7': mechanical break 69.1': 48 deg., mod. close, smooth, narrow-wide, lt. olive gray & dusky yellow clay fill 69.2': mechanical break 70.7': 58 deg., close, smooth, tight, narrow, dusky yellow-mod. yellow fill 71.1': 54 deg., close, smooth, narrow, lt. olive gray clay fill 72.1': 26 deg., close, smooth, narrow-tight, poss. mech. break	70	100	93
73.4' Dk. gray-grayish black & some pale olive, soft-hard, unweathered STRUCTURE: 74.4': mechanical break 74.9': mechanical break 75.1': mechanical break 75.8': mod. close, smooth, tr. lt. brown stain	75	100	96
76.2' Hard, very sli. weathered-unweathered STRUCTURE: 76.6': mechanical break 77.2': 42 deg., close, smooth, narrow, lt. olive brown mineral 78.1': 58 & 20 deg. (2), close, smooth-sli. rough, narrow, lt. olive brown mineral 79.5 46 deg., mod. close, smooth, narrow-wide, tr. white mineral 80.5' 46 deg., close-mod. close, smooth, narrow, tr. lt. olive brown mineral 81.2': mechanical break	80	100	100
81.2' Speckled grayish black & pale olive, hard, unweathered, coarse grained STRUCTURE: 81.6': 42 deg., close, smooth, narrow-v. narrow, clean 82.2': 48 deg., close, smooth, v. narrow-narrow, lt. olive brn.-			

Fill Auger SPT RB Cored

(c) (d) (a) (b)

dusky yel low fill
82.8': mechanical break
83.8': mod. close, smooth, v. wide, mod. yellow fill
83.9': 54 deg., v. close, smooth, wide, tr. dusky yellow stain
85.5': mechanical break

100 100

85

85.5' Slightly weathered in part

STRUCTURE:
85.5'-85.8': shattered, possibly mechanical
85.9': 39 deg., mod. close, smooth, narrow-wide, mod. yell. stain/fill, tr. slickensides?
86.0': 72 deg., v. close, smooth, v. narrow, yell. gray-pale olive stain/fill
86.4': 28 deg., close, smooth, wide, clean
86.6': 48 deg., close, sli. rough, narrow, pale olive stain, slickensides?
87.0': 40 deg., close, smooth-sli. rough, narrow-wide, yell. gray-lt. olive gray stain
87.1': 32 deg., v. close, smooth, wide, clean
87.4': several tight fracture? lines w/ yell. gray clay fill
87.7,: 52 deg., close, smooth-sli. rough, wide, pale olive mineralization
88.5': mechanical break
88.6': 42 deg., close-mod. close, tight, yell. gray clay fill
89.0': 40 deg., close, smooth-sli. rough, v. narrow, yell. gray-pale olive stain/fill
88.9': 34 deg., close, smooth, narrow-wide, tr. lt. brown stain
89.9-90.4': 74 deg., smooth, narrow, dusky yellow mineralization

98 80

90

90.5' As above, hard, unweathered

102

STRUCTURE:
90.5'-90.8': rubble
90.8': mechanical break
91.7': 34 deg., mod. close, smooth, narrow, dusky yellow-pale olive fill
92.3': mechanical break
92.7': 40 deg., mod. close, smooth, v. narrow, clean
93.1'-93.6': several close 62 deg., tight fractures, tr. yell. gray fill
93.6': 40 deg., close, smooth, narrow, yell. gray-pale olive fill
94.6': 46 deg., close-mod. close, smooth, narrow, dusky yellow fill
94.7': 46 deg., v. close, smooth, narrow-wide, sli. tr. pinpoint vuggy porosity w/ fine void fill quartz? crystals
95.5': 50 deg., close, smooth, narrow, yell. gray clay fill, tr. pinpoint vuggy porosity w/ fine void fill quartz? crystals
96.1': 40 deg., close, smooth-sli. rough, narrow, lt. olive mineral fill
96.2': 36 deg., very close, smooth, narrow, clean
96.6': 44 deg., close, smooth, narrow, sli. tr. yell. gray clay fill

95

100 100

TOP ELEV: 232.3 COMPLETED: April 21, 1997

(c) (d) (a) (b)

100.5

98.9': mechanical break
99.5': 50 deg., mod. close, smooth, narrow, yell. gray-pale olive stain/fill
99.9' 40 deg., close, smooth, narrow, yell. gray clay fill
99.9'-100.5': several close-very closely spaced tight 40 deg., some showing tr. pinpoint vuggy porosity

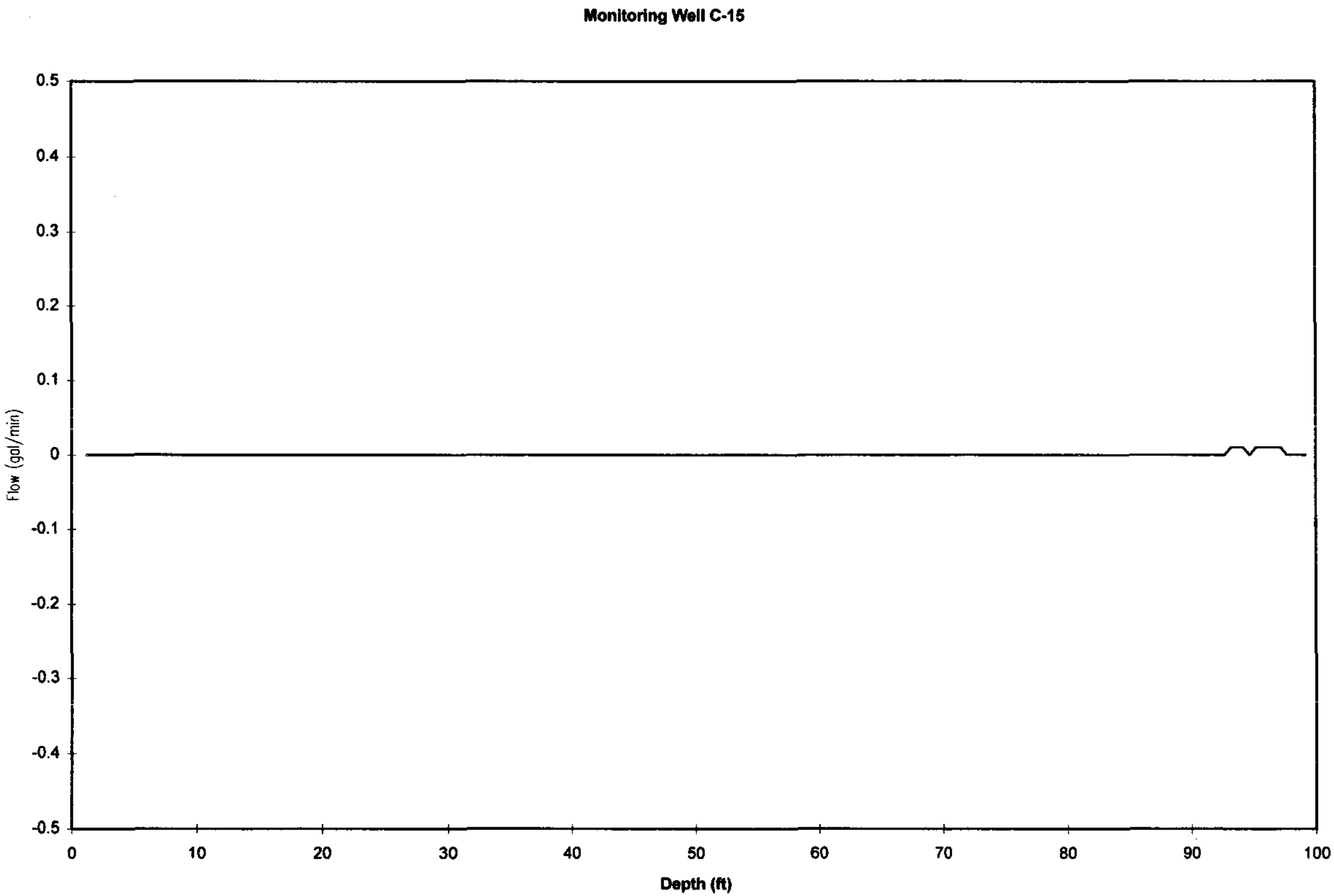
BOTTOM OF HOLE

100
105
110
115

ADDITIONAL GROUNDWATER DATA:
Hole was not bailed before completion reading.
24 Hr. reading was taken from top of casing.

DRILLING PROCEDURE:
Drilling ws accomplished using the CME 750 & Failing F-6 rigs. The upper 35' of overburden was augered using 4-1/4" ID HSAs. Begining at 35' below ground surface, samples were collected on 5' centers using 1-3/8" ID split spoons following SPT procedures. The hole was advanced between sampl es using the 4-1/4"ID HSA. Rock was cored using an HQ bit and water until 65' BGS. The borehole was augered to 65' with the 4-1/4"ID HSAs before being enlarged with 6-1/4" HSAs. After reaugering, PVC riser was grouted to 65', and the boring was cored with HQ bit to a final total depth of 100.5' BGS. Little or no water was lost during coring operations. The boring was completed as an open hole monitoring well.

Fill Auger SPT RB Cored



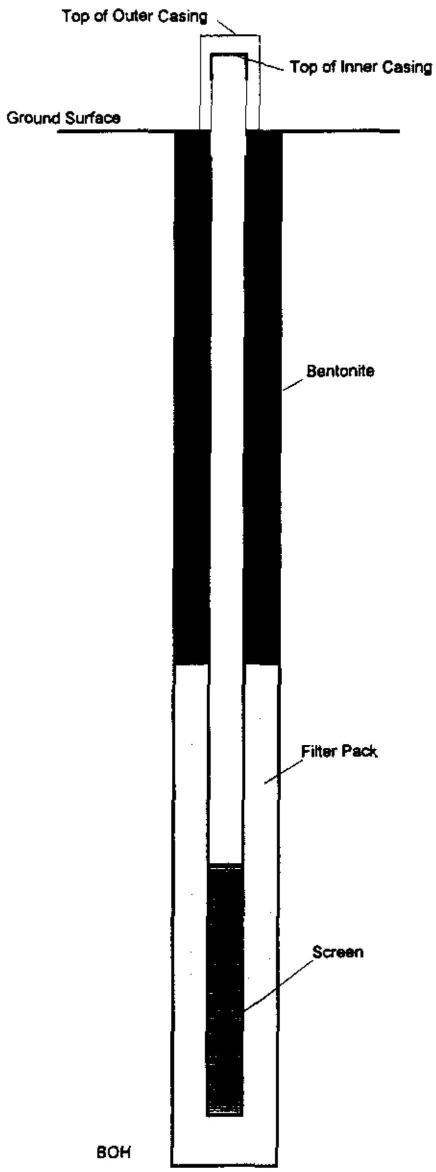
Monitoring Well C-15
0.5
0.4
0.3
0.2
0.1
0
-0.1
-0.2
-0.3
-0.4
-0.5
Flow (gal/min)
0
10
20
30
40
50
60
70
80
90
100
Depth (ft)

Appendix B

Well Completion and Development Records

AS BUILT MONITORING WELL RECORD

HOLE NUMBER: C-5	LOCATION:	Adelphi, MD		DRILLER: McNamara
PROJECT: ALC-RI		ELEVATIONS (FT MSL)		DEPTH TO GW (FT)*: 20.2'
DATE WELL COMPLETED: 5/30/96		SURFACE:	213.5'	DRILLING METHOD: HSA
DEVELOPMENT COMPLETED: 6/11/96		TOP OF PVC CASING:	215.24'	DEVELOPMENT METHOD:
INSPECTOR: Brock/ Dimbirs		TOP OF OUTER CASING:		Hand Pump



COORDINATES:	
DEPTH TO TOP OF OUTERCASING:	2.6' stickup
DEPTH TO TOP OF INNER CASING:	2' stickup
TYPE OF SURFACE SEAL:	3/8" bentonite pellets
DEPTH OF SEAL:	13.5'
I.D. OF SURFACE CASING:	0.5'x0.5'
TYPE OF SURFACE CASING:	steel well protector
I.D.OF RISER PIPE:	2"
TYPE OF RISER PIPE:	sched 40 PVC
TYPE OF GROUT:	N/A
TYPE OF SEEPAGE PROTECTOR	N/A
DEPTH TO TOP OF PROTECTOR	
DEPTH TO TOP OF SEAL:	surface
TYPE OF SEAL:	3/8" hydrated bentonite pellets
DEPTH TO TOP OF FILTER PACK:	13.5'
TYPE OF FILTER PACK:	Morie "00" sand
DEPTH TO TOP OF SCREEN:	16.0'
TYPE OF SCREEN:	PVC sched 40
SLOT SIZE AND LENGTH:	0.010 x 20'
I.D. OF SCREEN:	2"
DEPTH TO BOTTOM OF SCREEN:	36.0'
BOREHOLE DIAMETER:	11 5/8"
BOTTOM OF HOLE:	36.0'

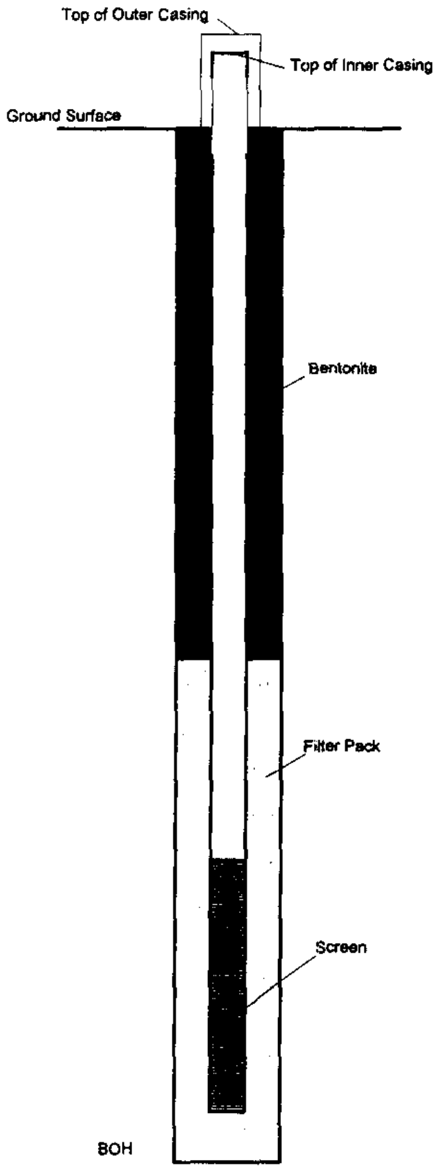
* Depth to groundwater measured relative to ground surface

USACE - Baltimore District

PROJECT: Adelphi Laboratory Center RI	HOLE NO.: C-5

AS BUILT MONITORING WELL RECORD

HOLE NUMBER: C-6	LOCATION:	Adelphi, MD		DRILLER: McNamara
PROJECT: ALC-RI		ELEVATIONS (FT MSL)		DEPTH TO GW (FT)*: 15.2'
DATE WELL COMPLETED: 5/24/96		SURFACE:	232.5'	DRILLING METHOD: HSA
DEVELOPMENT COMPLETED: 6/1/96		TOP OF PVC CASING:	234.47'	DEVELOPMENT METHOD:
INSPECTOR: Brock/ Dimbirs		TOP OF OUTER CASING:		Hand Pump



COORDINATES:	
DEPTH TO TOP OF OUTERCASING:	2.6' stickup
DEPTH TO TOP OF INNER CASING:	2' stickup
TYPE OF SURFACE SEAL:	3/8" bentonite pellets
DEPTH OF SEAL:	6.5'
I.D. OF SURFACE CASING:	0.5'x0.5'
TYPE OF SURFACE CASING:	steel well protector
I.D.OF RISER PIPE:	2"
TYPE OF RISER PIPE:	sched 40 PVC
TYPE OF GROUT:	N/A
TYPE OF SEEPAGE PROTECTOR	N/A
DEPTH TO TOP OF PROTECTOR	
DEPTH TO TOP OF SEAL:	surface
TYPE OF SEAL:	3/8" hydrated bentonite pellets
DEPTH TO TOP OF FILTER PACK:	6.5'
TYPE OF FILTER PACK:	Morie "00" sand
DEPTH TO TOP OF SCREEN:	9.1'
TYPE OF SCREEN:	PVC sched 40
SLOT SIZE AND LENGTH:	0.010 x 20'
I.D. OF SCREEN:	2"
DEPTH TO BOTTOM OF SCREEN:	29.1'
BOREHOLE DIAMETER:	11 5/8"
BOTTOM OF HOLE:	31.5'

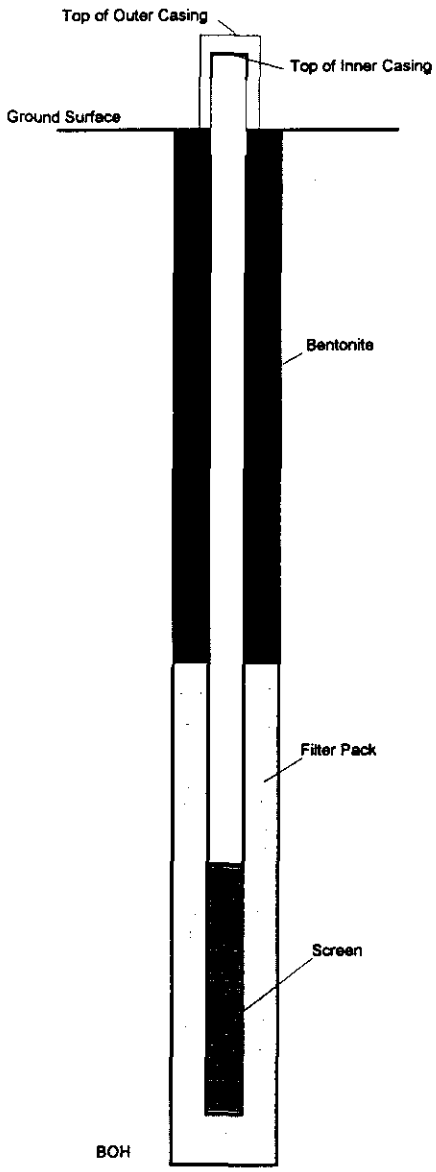
* Depth to groundwater measured relative to ground surface

USACE - Baltimore District

PROJECT: Adelphi Laboratory Center RI	HOLE NO.: C-6

AS BUILT MONITORING WELL RECORD

HOLE NUMBER: C-7	LOCATION: Adelphi, MD			DRILLER: McNamara
PROJECT: ALC-RI	ELEVATIONS (FT MSL)			DEPTH TO GW (FT)*: 4.6'
DATE WELL COMPLETED: 6/5/96	SURFACE:	220.6'		DRILLING METHOD: HSA
DEVELOPMENT COMPLETED: 6/14/96	TOP OF PVC CASING:	222.49'		DEVELOPMENT METHOD:
INSPECTOR: Brock/ Dimbirs	TOP OF OUTER CASING:			Hand Pump/ Actuator



COORDINATES:	
DEPTH TO TOP OF OUTERCASING:	2.6' stickup
DEPTH TO TOP OF INNER CASING:	2' stickup
TYPE OF SURFACE SEAL:	3/8" bentonite pellets
DEPTH OF SEAL:	1.5'
I.D. OF SURFACE CASING:	0.5'x0.5'
TYPE OF SURFACE CASING:	steel well protector
I.D.OF RISER PIPE:	2"
TYPE OF RISER PIPE:	sched 40 PVC
TYPE OF GROUT:	N/A
TYPE OF SEEPAGE PROTECTOR	N/A
DEPTH TO TOP OF PROTECTOR	
DEPTH TO TOP OF SEAL:	surface
TYPE OF SEAL:	3/8" hydrated bentonite pellets
DEPTH TO TOP OF FILTER PACK:	1.5'
TYPE OF FILTER PACK:	Morie "00" sand
DEPTH TO TOP OF SCREEN:	2.8'
TYPE OF SCREEN:	PVC sched 40
SLOT SIZE AND LENGTH:	0.010 x 20'
I.D. OF SCREEN:	2"
DEPTH TO BOTTOM OF SCREEN:	22.8'
BOREHOLE DIAMETER:	11 5/8"
BOTTOM OF HOLE:	23.5'

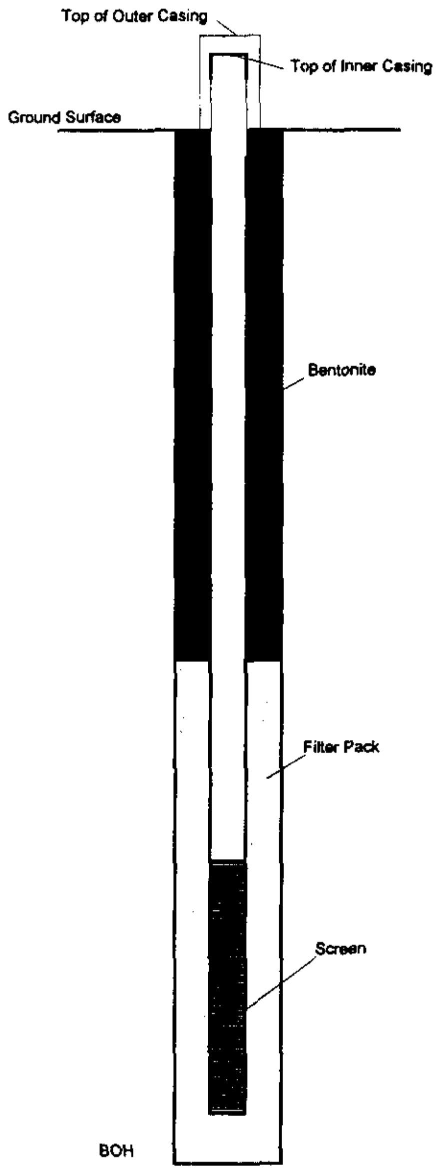
* Depth to groundwater measured relative to ground surface

USACE - Baltimore District

PROJECT: Adelphi Laboratory Center RI	HOLE NO.: C-7

AS BUILT MONITORING WELL RECORD

HOLE NUMBER: C-8	LOCATION:	Adelphi, MD	DRILLER:	McNamara
PROJECT: ALC-RI	ELEVATIONS (FT MSL)		DEPTH TO GW (FT)*:	4.5'
DATE WELL COMPLETED: 6/6/96	SURFACE:	211.6'	DRILLING METHOD: HSA	
DEVELOPMENT COMPLETED: 6/13/96	TOP OF PVC CASING:	213.17'	DEVELOPMENT METHOD:	
INSPECTOR: Brock/ Dimbirs	TOP OF OUTER CASING:		Hand Pump/ Actuator	



COORDINATES:	
DEPTH TO TOP OF OUTERCASING:	2.6' stickup
DEPTH TO TOP OF INNER CASING:	2' stickup
TYPE OF SURFACE SEAL:	3/8" bentonite pellets
DEPTH OF SEAL:	2.1'
I.D. OF SURFACE CASING:	0.5'x0.5'
TYPE OF SURFACE CASING:	steel well protector
I.D.OF RISER PIPE:	2"
TYPE OF RISER PIPE:	sched 40 PVC
TYPE OF GROUT:	N/A
TYPE OF SEEPAGE PROTECTOR	N/A
DEPTH TO TOP OF PROTECTOR	
DEPTH TO TOP OF SEAL:	surface
TYPE OF SEAL:	3/8" hydrated bentonite pellets
DEPTH TO TOP OF FILTER PACK:	2.1'
TYPE OF FILTER PACK:	Morie "00" sand
DEPTH TO TOP OF SCREEN:	3.4'
TYPE OF SCREEN:	PVC sched 40
SLOT SIZE AND LENGTH:	0.010 x 20'
I.D. OF SCREEN:	2"
DEPTH TO BOTTOM OF SCREEN:	23.4'
BOREHOLE DIAMETER:	11 5/8"
BOTTOM OF HOLE:	23.5'

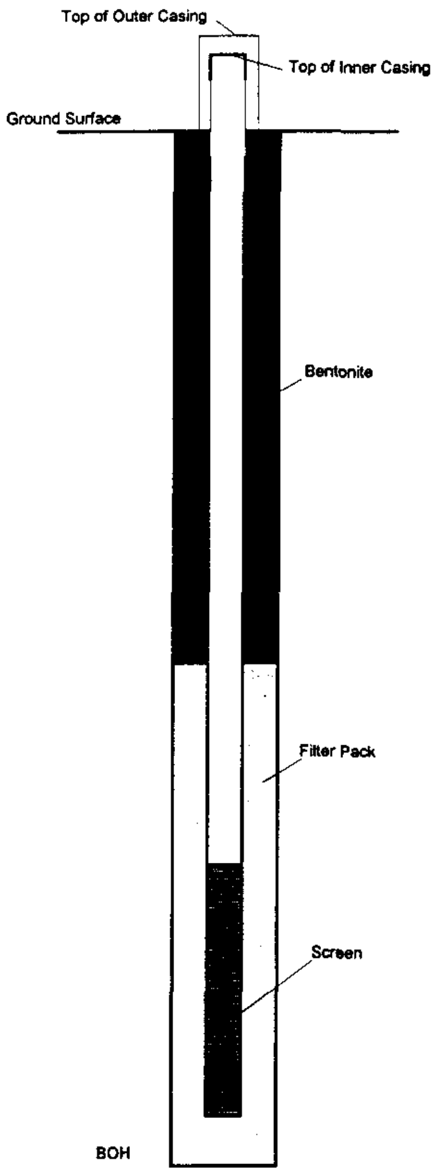
* Depth to groundwater measured relative to ground surface

USACE - Baltimore District

PROJECT: Adelphi Laboratory Center RI	HOLE NO.: C-8

AS BUILT MONITORING WELL RECORD

HOLE NUMBER: C-9	LOCATION:	Adelphi, MD		DRILLER:	McNamara
PROJECT: ALC-RI		ELEVATIONS (FT MSL)		DEPTH TO GW (FT)*:	9.2'
DATE WELL COMPLETED: 5/21/96		SURFACE:	203.2'	DRILLING METHOD:	HSA
DEVELOPMENT COMPLETED: N/A		TOP OF PVC CASING:	204.47'	DEVELOPMENT METHOD:	
INSPECTOR: Brock/ Dimbirs		TOP OF OUTER CASING:			N/A



COORDINATES:	
DEPTH TO TOP OF OUTERCASING:	2.6' stickup
DEPTH TO TOP OF INNER CASING:	1.6' stickup
TYPE OF SURFACE SEAL:	3/8" bentonite pellets
DEPTH OF SEAL:	2.0'
I.D. OF SURFACE CASING:	0.5'x0.5'
TYPE OF SURFACE CASING:	steel well protector
I.D.OF RISER PIPE:	1"
TYPE OF RISER PIPE:	sched 40 PVC
TYPE OF GROUT:	N/A
TYPE OF SEEPAGE PROTECTOR	N/A
DEPTH TO TOP OF PROTECTOR	
DEPTH TO TOP OF SEAL:	surface
TYPE OF SEAL:	3/8" hydrated bentonite pellets
DEPTH TO TOP OF FILTER PACK:	2.0'
TYPE OF FILTER PACK:	Morie "00" sand
DEPTH TO TOP OF SCREEN:	4.5'
TYPE OF SCREEN:	PVC sched 40
SLOT SIZE AND LENGTH:	0.010 x 20'
I.D. OF SCREEN:	1"
DEPTH TO BOTTOM OF SCREEN:	24.5'
BOREHOLE DIAMETER:	6 1/2"
BOTTOM OF HOLE:	24.5'

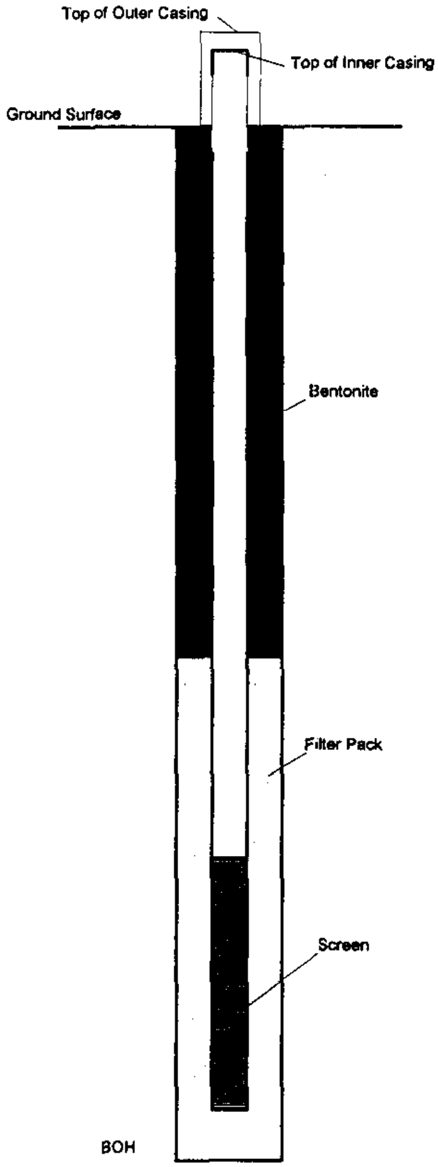
* Depth to groundwater measured relative to ground surface

USACE - Baltimore District

PROJECT:	Adelphi Laboratory Center RI	HOLE NO.:	C-9

AS BUILT MONITORING WELL RECORD

HOLE NUMBER: C-10	LOCATION: Adelphi, MD		DRILLER: McNamara
PROJECT: ALC-RI	ELEVATIONS (FT MSL)		DEPTH TO GW (FT)*: 4.3'
DATE WELL COMPLETED: 5/15/96	SURFACE:	189.8'	DRILLING METHOD: HSA
DEVELOPMENT COMPLETED: N/A	TOP OF PVC CASING:	191.93'	DEVELOPMENT METHOD: N/A
INSPECTOR: Brock/ Dimbirs	TOP OF OUTER CASING:		



COORDINATES:	
DEPTH TO TOP OF OUTERCASING:	2.6' stickup
DEPTH TO TOP OF INNER CASING:	2.0' stickup
TYPE OF SURFACE SEAL:	3/8" bentonite pellets
DEPTH OF SEAL:	3.0'
I.D. OF SURFACE CASING:	0.5'x0.5'
TYPE OF SURFACE CASING:	steel well protector
I.D.OF RISER PIPE:	1"
TYPE OF RISER PIPE:	sched 40 PVC
TYPE OF GROUT:	N/A
TYPE OF SEEPAGE PROTECTOR	N/A
DEPTH TO TOP OF PROTECTOR	
DEPTH TO TOP OF SEAL:	surface
TYPE OF SEAL:	3/8" hydrated bentonite pellets
DEPTH TO TOP OF FILTER PACK:	3.0'
TYPE OF FILTER PACK:	Morie "00" sand
DEPTH TO TOP OF SCREEN:	4.9'
TYPE OF SCREEN:	PVC sched 40
SLOT SIZE AND LENGTH:	0.010 x 20'
I.D. OF SCREEN:	1"
DEPTH TO BOTTOM OF SCREEN:	24.9'
BOREHOLE DIAMETER:	6 1/2"
BOTTOM OF HOLE:	24.9'

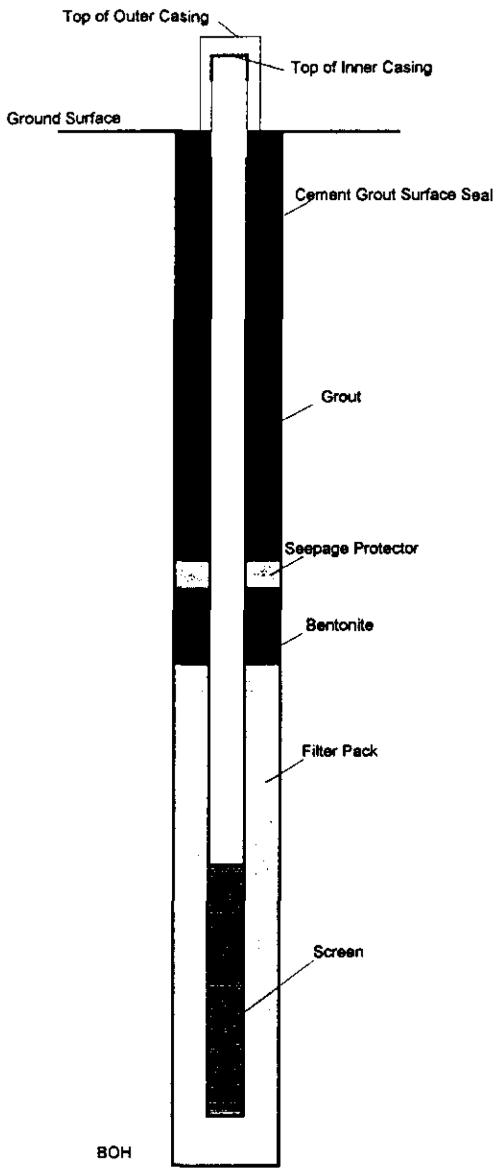
* Depth to groundwater measured relative to ground surface

USACE - Baltimore District

PROJECT: Adelphi Laboratory Center RI	HOLE NO.: C-10

AS BUILT MONITORING WELL RECORD

HOLE NUMBER:	C-11	LOCATION:	Adelphi, MD	DRILLER:	McNamara
PROJECT:	ALC-RI	ELEVATIONS (FT MSL)		DEPTH TO GW (FT)*:	17.6'
DATE WELL COMPLETED:	5/21/96	SURFACE:	187.5'	DRILLING METHOD:	HSA, rot. bit
DEVELOPMENT COMPLETED:	6/14/96	TOP OF PVC CASING:	189.70'	DEVELOPMENT METHOD:	
INSPECTOR:	Brock/ Dimbirs	TOP OF OUTER CASING:			Hand Pump/ Bailer



COORDINATES:	
DEPTH TO TOP OF OUTERCASING:	2.6' stickup
DEPTH TO TOP OF INNER CASING:	2' stickup
TYPE OF SURFACE SEAL:	cement
DEPTH OF SEAL:	
I.D. OF SURFACE CASING:	0.5'x0.5'
TYPE OF SURFACE CASING:	steel well protector
I.D.OF RISER PIPE:	2"
TYPE OF RISER PIPE:	sched 40 PVC
TYPE OF GROUT:	cement bentonite
TYPE OF SEEPAGE PROTECTOR	FJ90 sand
DEPTH TO TOP OF PROTECTOR	52.1'
DEPTH TO TOP OF SEAL:	53.0'
TYPE OF SEAL:	3/8" hydrated bentonite pellets
DEPTH TO TOP OF FILTER PACK:	61.3'
TYPE OF FILTER PACK:	Morie "00" sand
DEPTH TO TOP OF SCREEN:	64.6'
TYPE OF SCREEN:	PVC sched 40
SLOT SIZE AND LENGTH:	0.010 x 10'
I.D. OF SCREEN:	2"
DEPTH TO BOTTOM OF SCREEN:	74.6'
BOREHOLE DIAMETER:	5 5/8"
BOTTOM OF HOLE:	74.6'

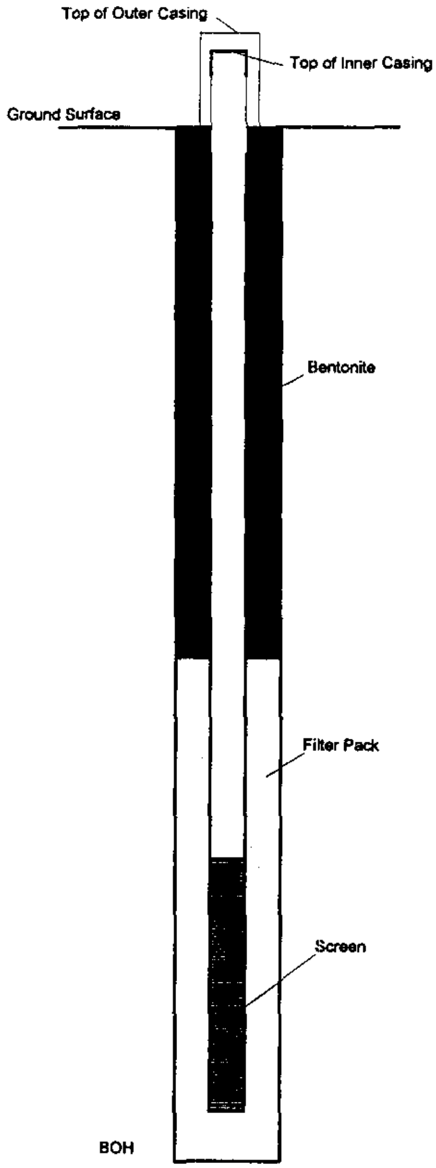
* Depth to groundwater measured relative to ground surface

USACE - Baltimore District

PROJECT:	*Adelphi Laboratory Center RI*	*HOLE NO.:*	C-11

AS BUILT MONITORING WELL RECORD

HOLE NUMBER: C-12	LOCATION: Adelphi, MD		DRILLER: McNamara	
PROJECT: ALC-RI	ELEVATIONS (FT MSL)		DEPTH TO GW (FT)*: 10.3'	
DATE WELL COMPLETED: 5/22/96	SURFACE:	188.0'	DRILLING METHOD: HSA, rot. bit	
DEVELOPMENT COMPLETED: 6/14/96	TOP OF PVC CASING:	189.95'	DEVELOPMENT METHOD:	
INSPECTOR: Brock/ Dimbirs	TOP OF OUTER CASING:		Hand Pump/ Actuator	



COORDINATES:	
DEPTH TO TOP OF OUTERCASING:	2.4' stickup
DEPTH TO TOP OF INNER CASING:	2' stickup
TYPE OF SURFACE SEAL:	3/8" bentonite pellets
DEPTH OF SEAL:	2.9'
I.D. OF SURFACE CASING:	0.5'x0.5'
TYPE OF SURFACE CASING:	steel well protector
I.D.OF RISER PIPE:	2"
TYPE OF RISER PIPE:	sched 40 PVC
TYPE OF GROUT:	N/A
TYPE OF SEEPAGE PROTECTOR	N/A
DEPTH TO TOP OF PROTECTOR	
DEPTH TO TOP OF SEAL:	surface
TYPE OF SEAL:	3/8" hydrated bentonite pellets
DEPTH TO TOP OF FILTER PACK:	2.9'
TYPE OF FILTER PACK:	Morie "00" sand
DEPTH TO TOP OF SCREEN:	5.3'
TYPE OF SCREEN:	PVC sched 40
SLOT SIZE AND LENGTH:	0.010 x 20'
I.D. OF SCREEN:	2"
DEPTH TO BOTTOM OF SCREEN:	25.3'
BOREHOLE DIAMETER:	11 5/8"
BOTTOM OF HOLE:	33.3'

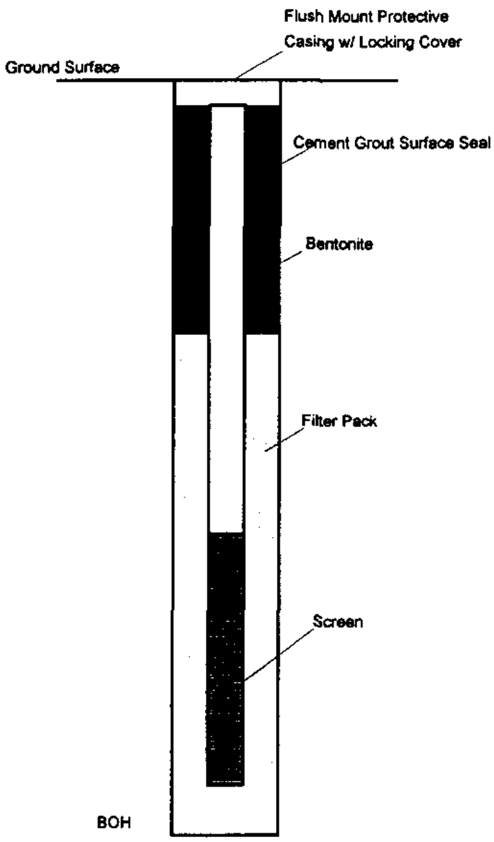
* Depth to groundwater measured relative to ground surface

USACE - Baltimore District

PROJECT: Adelphi Laboratory Center RI	HOLE NO.: C-12

AS BUILT MONITORING WELL RECORD

HOLE NUMBER: C-13	LOCATION:	Adelphi, MD		DRILLER: McNamara
PROJECT: ALC-RI		ELEVATIONS (FT MSL)		DEPTH TO GW (FT)*: 3.0'
DATE WELL COMPLETED: 6/22/96		SURFACE:	180.5'	DRILLING METHOD: HSA
DATE DEVELOPMENT COMPLET 6/24/96		TOP OF PVC CASING:	180.10'	DEVELOPMENT METHOD:
INSPECTOR: Brock/ Dimbirs		TOP OF OUTER CASING:		Bailer



COORDINATES:

HEIGHT TO TOP OF RISER PIPE: 0.4' BGS

TYPE OF SURFACE SEAL: Sika grout
DEPTH OF SEAL:

I.D. OF SURFACE CASING: 8"
TYPE OF SURFACE CASING: flush mount cover

I.D.OF RISER PIPE: 2"
TYPE OF RISER PIPE: sched 40 PVC

TYPE OF GROUT: N/A

TYPE OF SEEPAGE PROTECTOR: N/A
DEPTH TO TOP OF PROTECTOR:

DEPTH TO TOP OF SEAL: 0.6'
TYPE OF SEAL: 3/8" hydrated bentonite pellets

DEPTH TO TOP OF FILTER PACK: 0.8'
TYPE OF FILTER PACK: Morie "00" sand

DEPTH TO TOP OF SCREEN: 1.0'
TYPE OF SCREEN: PVC sched 40
SLOT SIZE AND LENGTH: 0.010 x 10'
I.D. OF SCREEN: 2"

DEPTH TO BOTTOM OF SCREEN: 11.0'
BOREHOLE DIAMETER: 11 5/8"

BOTTOM OF HOLE: 12.0'

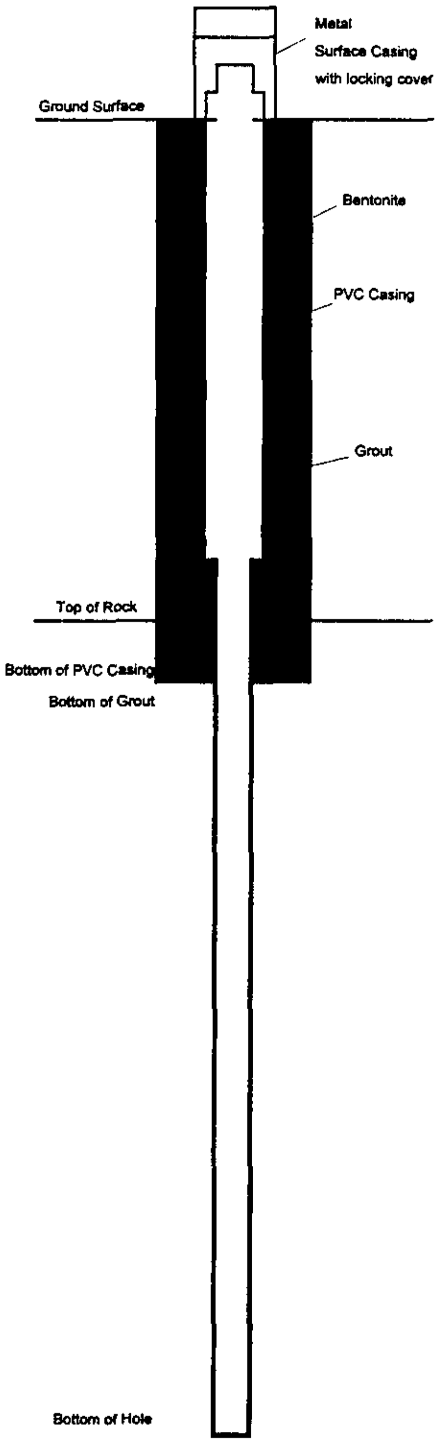
* Depth to groundwater measured relative to ground surface

USACE - Baltimore District

PROJECT: Adelphi Laboratory Center RI	HOLE NO.: C-13

AS BUILT MONITORING WELL RECORD

HOLE NUMBER: C-14		DRILLER: Bowden/McNamara/Kyle
PROJECT: Remedial Investigation at the Building 500 Area	LOCATION: Adelphi, MD	DRILLING METHOD: HSA, HQ core
SURFACE ELEVATION: 232.3 ft	HOLE LOCATION:	DEVELOPMENT METHOD: hand
DATE WELL COMPLETED: 4/21/97	DATE DEVELOPMENT COMPLETED: 4/30/97	swabbing, Aardvark
INSPECTOR: Griffith/Dimbirs/Creamer	DEPTH TO WATER: 13.8 ft	DATE: 5/8/97

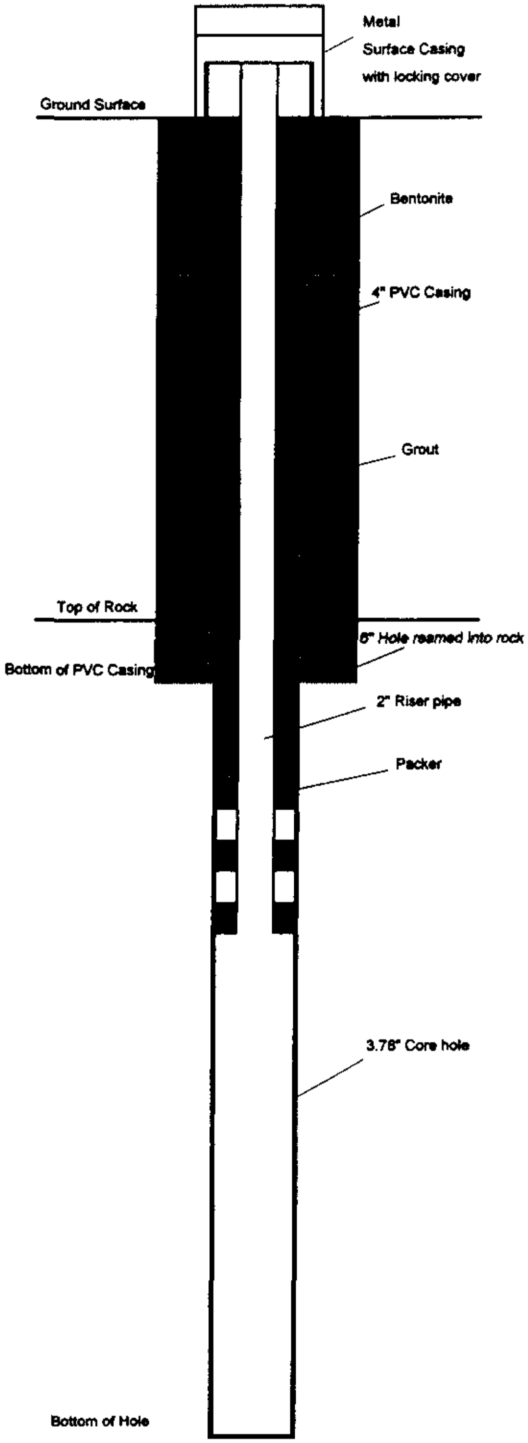


HEIGHT TO TOP OF RISER PIPE:	2.0' stickup
TYPE OF SURFACE SEAL:	med. bentonite chips
DEPTH OF SEAL:	3.0'
I.D. OF SURFACE CASING:	0.5'x0.5'
TYPE OF SURFACE CASING:	steel well protector
I.D.OF RISER PIPE:	4"
TYPE OF RISER PIPE:	sched 40 PVC
TYPE OF GROUT:	Type I cement/bentonite
DEPTH TO TOP OF ROCK:	50.7'
DEPTH TO BASE OF GROUT SEAL:	65.0'
DEPTH TO TOP OF FILTER PACK:	
TYPE OF FILTER PACK:	none
DEPTH TO TOP OF UNCASED ROCK:	65.0'
DIAMETER OF COREHOLE:	3.78"
BOTTOM OF HOLE:	100.5'

FIGURE ---	PROJECT: Remedial Investigation at the Building 500 Area	HOLE NO.: C-14

AS BUILT MONITORING WELL RECORD

HOLE NUMBER: C-14		DRILLER: Bowden/McNamara/Kyle
PROJECT: Remedial Investigation at the Building 500 Area	LOCATION: Adelphi, MD	DRILLING METHOD: HSA, HQ core
SURFACE ELEVATION: 232.3 ft	HOLE LOCATION:	DEVELOPMENT METHOD: hand
DATE WELL COMPLETED: 4/21/97	DATE DEVELOPMENT COMPLETED: 4/30/97	swabbing, Aardvark
INSPECTOR: Griffith/Dimbirs/Creamer	DEPTH TO WATER: 13.8 ft	DATE: 5/8/97, modified 1/9/98

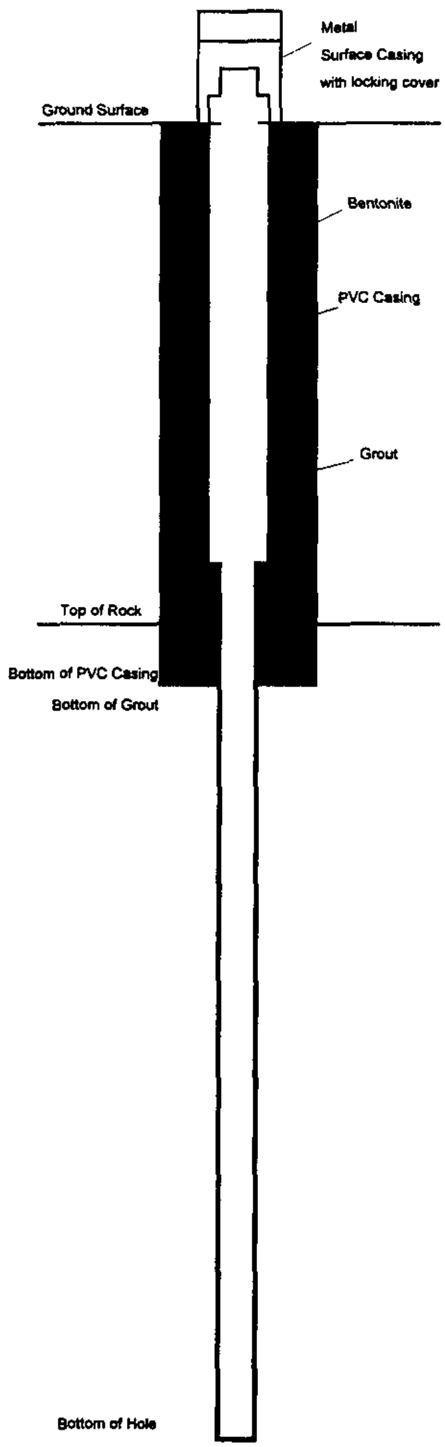


HEIGHT TO TOP OF RISER PIPE:	2.0' stickup
TYPE OF SURFACE SEAL:	med. bentonite chips
DEPTH OF SEAL:	3.0'
I.D. OF SURFACE CASING:	0.5'x0.5'
TYPE OF SURFACE CASING:	steel well protector
I.D.OF RISER PIPE:	4"
TYPE OF RISER PIPE:	sched 40 PVC
TYPE OF GROUT:	Type I cement/bentonite
DEPTH TO TOP OF ROCK:	50.7'
DEPTH TO BASE OF GROUT SEAL:	65.0'
DEPTH TO TOP OF FILTER PACK:	
TYPE OF FILTER PACK:	none
DEPTH TO TOP PACKER:	70.5'
DEPTH TO BOTTOM PACKER:	72'
DEPTH TO TOP OF UNCASED ROCK:	72'
DIAMETER OF COREHOLE:	3.78"
BOTTOM OF HOLE:	100.5'

FIGURE —	PROJECT: Remedial Investigation at the Building 500 Area	HOLE NO.: C-14

AS BUILT MONITORING WELL RECORD

HOLE NUMBER: C-15		DRILLER: Bowden/McNamara/Kyle
PROJECT: Remedial Investigation at the Building 500 Area	LOCATION: Adelphi, MD	DRILLING METHOD: HSA, HQ core
SURFACE ELEVATION: 220.3 ft	HOLE LOCATION:	DEVELOPMENT METHOD: Hand surging, Aardvark
DATE WELL COMPLETED: 4/22/97	DATE DEVELOPMENT COMPLETED: 4/25/97	
INSPECTOR: Griffith/Dimbirs/Creamer	DEPTH TO WATER: 6.3 ft	DATE: 5/8/97



HEIGHT TO TOP OF RISER PIPE:	2.0' stickup
TYPE OF SURFACE SEAL:	med. bentonite chips
DEPTH OF SEAL:	3.0'
I.D. OF SURFACE CASING:	0.5'x0.5'
TYPE OF SURFACE CASING:	steel well protector
I.D.OF RISER PIPE:	4"
TYPE OF RISER PIPE:	sched 40 PVC
TYPE OF GROUT:	Type I cement/bentonite
DEPTH TO TOP OF ROCK:	50.7'
DEPTH TO BASE OF GROUT SEAL:	60.0'
DEPTH TO TOP OF FILTER PACK:	
TYPE OF FILTER PACK:	none
DEPTH TO TOP OF UNCASED ROCK:	60.0'
BOREHOLE DIAMETER:	3.78"
BOTTOM OF HOLE:	100.1'

	PROJECT:	HOLE NO.:
	Remedial Investigation at the Building 500 Area	C-15

Well # C-5

MONITORING WELL DEVELOPMENT RECORD

Project: Adelphi Laboratory Center - RI
Location: Adelphi, MD
Inspector: Brock/ Dimbers
Installation Date: 5/30/96 Development Date: 6/4/96, 6/6/96, 6/11/96

Well Construction Details		
Total Well Depth 36.0'	Riser 2.0' stick-up	Screened Interval 16.0'-36.0'
Borehole Diameter 11 5/8"	Well Diameter 2"	Static Water Level 20.2'

Method of Development: Hand Pump
Pumping Rate:
Pump Depth(s): screen swabbed, then pumped from near bottom of the well
Development Start Time: 6/4/96 @ 1355 hrs Stop time: 6/11/96 @ 1400 hrs

Physical Appearance:
Initial reddish-brown, silty
During tan, cloudy
Final brown, cloudy

Well Volume (including filter pack): 21 gallons

Field Analysis

	Initial	Volume # 1	Volume # 2	Volume # 3	Volume #4
Time	N/A	6/4 @ 1550	6/4 @ 1640	6/6 @ 0800	6/6@ 0850
Turbidity (NTU)	N/A	>1000	79.2	386	>1000
Conductivity (μs/cm)	N/A	0.91×10^3	1.48×10^2	5.05×10^2	1.16×10^2
pH	N/A	8.90	7.47	8.30	7.95
Temperature (°F)	N/A	70	66.3	58.5	60.6

Total Quantity of Water Removed: 250 gallons
Method of Water Disposal: water was disposed of atleast 50' away from well onto ground
Sample Jar Collected:

Comments: This well was developed over the amt. of time allotted and still did not clear up. Had to stop developing due to time constraint.

Well # C-5

MONITORING WELL DEVELOPMENT RECORD

Project: Adelphi Laboratory Center - RI
Location: Adelphi, MD
Inspector: Brock/ Dimbers
Installation Date: 5/30/96 Development Date: 6/4/96, 6/6/96, 6/11/96

Well Construction Details					
Total Well Depth	36.0'	Riser	2.0' stick-up	Screened Interval	16.0'-36.0'
Borehole Diameter	11 5/8"	Well Diameter	2"	Static Water Level	20.2'

Method of Development: Hand Pump
Pumping Rate:
Pump Depth(s): screen swabbed, then pumped from near bottom of the well
Development Start Time: 6/4/96 @ 1355 hrs Stop time: 6/11/96 @ 1400 hrs

Physical Appearance:
Initial reddish-brown, silty
During tan, cloudy
Final brown, cloudy

Well Volume (including filter pack): 21 gallons

Field Analysis	Volume #5	Volume #6	Volume #7	Volume # 8	Final
Time	6/6 @ 0940	6/11 @ 1300	6/11 @ 1330	6/11 @ 1400	6/11 @ 1420
Turbidity (NTU)	640	189	238	332	not taken
Conductivity (μs/cm)	1.08×10^2	2.81×10^2	1.40×10^2	1.20×10^2	not taken
pH	7.39	9.2	8.67	8.45	not taken
Temperature (°F)	61.5	69	64.7	66.6	not taken

Total Quantity of Water Removed:
Method of Water Disposal:
Sample Jar Collected:

Comments:

Well # C-6

MONITORING WELL DEVELOPMENT RECORD

Project: Adelphi Laboratory Center - RI
Location: Adelphi, MD
Inspector: Brock/ Dimbers
Installation Date: 5/24/96 Development Date: 5/31/96, 6/1/96

Well Construction Details					
Total Well Depth	29.1'	Riser	2.0' stick-up	Screened Interval	9.1'-29.1'
Borehole Diameter	11 5/8"	Well Diameter	2"	Static Water Level	10.9'

Method of Development: Hand Pump
Pumping Rate:
Pump Depth(s): near bottom of the well
Development Start Time: 5/31/96 @ 1500 hrs Stop time: 6/1/96 @ 1000 hrs

Physical Appearance:
- Initial: very dark brown, dirty
- During: cleared up a few times
- Final: clear

Well Volume (including filter pack): 15 gallons

Field Analysis

	Initial	Volume # 1	Volume # 2	Volume # 3	Volume #4
Time	N/A	5/31 @ 1528	5/31 @ 1555	5/31 @ 1613	6/1@ 0812
Conductivity (µs/cm)	N/A	1.24×10^2	1.54×10^2	1.98×10^2	2.35×10^2
pH	N/A	6.74	6.53	6.23	5.65
Temperature (°F)	N/A	76.2	72.8	67.4	54.2

Total Quantity of Water Removed: 500 gallons
Method of Water Disposal: water was disposed of atleast 50' away from well onto ground
Sample Jar Collected:

Comments: This well was developed over the amt. of time allotted.

Well # C-6

MONITORING WELL DEVELOPMENT RECORD

Project: Adelphi Laboratory Center - RI
Location: Adelphi, MD
Inspector: Brock/ Dimbers
Installation Date: 5/24/96 Development Date: 5/31/96, 6/1/96

Well Construction Details					
Total Well Depth	29.1'	Riser	2.0' stick-up	Screened Interval	9.1'-29.1'
Borehole Diameter	11 5/8"	Well Diameter	2"	Static Water Level	10.9'

Method of Development: Hand Pump
Pumping Rate:
Pump Depth(s): near bottom of the well
Development Start Time: 5/31/96 @ 1500 hrs Stop time: 6/1/96 @ 1000 hrs

Physical Appearance:
Initial very dark brown, dirty
During cleared up a few times
Final clear

Well Volume (including filter pack): 15 gallons

Field Analysis	Volume #5	Volume #6	Final		
Time	6/1 @ 0845	6/1 @ 0917	6/1 @ 1000		
Conductivity (µs/cm)	1.61×10^2	1.75×10^2	2.36×10^2		
pH	5.63	5.59	5.84		
Temperature (°F)	60.0	66.2	72.0		

Total Quantity of Water Removed:
Method of Water Disposal:
Sample Jar Collected:

Comments: Turbidity meter was 35.5 NTU at 500 gallons (total quantity of water removed).

Well # C-7

MONITORING WELL DEVELOPMENT RECORD

Project: Adelphi Laboratory Center - RI
Location: Adelphi, MD
Inspector: Brock/ Dimbers
Installation Date: 6/5/96 Development Date: 6/12/96 - 6/14/96

Well Construction Details					
Total Well Depth	22.8'	Riser	2.0' stick-up	Screened Interval	2.8'-22.8'
Borehole Diameter	11 5/8"	Well Diameter	2"	Static Water Level	4.6'

Method of Development: Hand Pump/ Actuator
Pumping Rate:
Pump Depth(s): screen swabbed, then pumped from near bottom of the well
Development Start Time: 6/12/96 @ 0815 hrs Stop time: 6/14/96 @ 1100 hrs

Physical Appearance:
Initial dark brown, silty
During light tan, cloudy
Final cloudy

Well Volume (including filter pack): 22 gallons

Field Analysis	Initial	Volume # 1	Volume # 2	Volume # 3	Volume #4
Time	N/A	6/12 @ 0915	6/12 @ 1350	6/12 @ 1500	6/12@ 1630
Turbidity (NTU)	N/A	>1000	768	288	80.5
Conductivity (µs/cm)	N/A	2.52×10^2	2.44×10^2	2.13×10^2	2.12×10^2
pH	N/A	8.17	7.91	7.85	7.32
Temperature (°F)	N/A	58.6	60.7	62.8	64.9

Total Quantity of Water Removed: 170 gallons
Method of Water Disposal: water was disposed of atleast 50' away from well onto ground
Sample Jar Collected:

Comments: This well was developed over the amt. of time allotted and was still a bit cloudy. Had to stop developing due to time constraint.

Well # C-7

MONITORING WELL DEVELOPMENT RECORD

Project: Adelphi Laboratory Center - RI
Location: Adelphi, MD
Inspector: Brock/ Dimbers
Installation Date: 6/5/96 Development Date: 6/12/96 - 6/14/96

Well Construction Details					
Total Well Depth	22.8'	Riser	2.0' stick-up	Screened Interval	2.8'-22.8'
Borehole Diameter	11 5/8"	Well Diameter	2"	Static Water Level	4.6'

Method of Development: Hand Pump/ Actuator
Pumping Rate:
Pump Depth(s): screen swabbed, then pumped from near bottom of the well
Development Start Time: 6/12/96 @ 0815 hrs Stop time: 6/14/96 @ 1100 hrs

Physical Appearance:
Initial dark brown, silty
During light tan, cloudy
Final cloudy

Well Volume (including filter pack): 22 gallons

Field Analysis	Volume #5	Volume #6	Final		
Time	6/13@ 1040	6/13 @ 1445	6/14 @ 1100		
Turbidity (NTU)	>1000	>1000	>1000		
Conductivity (μs/cm)	2.37×10^2	1.86×10^2	1.92×10^2		
pH	7.65	7.40	9.10		
Temperature (°F)	63.2	67.1	64.4		

Total Quantity of Water Removed:
Method of Water Disposal:
Sample Jar Collected:

Comments:

Well # C-8

MONITORING WELL DEVELOPMENT RECORD

Project: Adelphi Laboratory Center - RI
Location: Adelphi, MD
Inspector: Brock/ Dimbers
Installation Date: 6/6/96 Development Date: 6/12/96 - 6/13/96

Well Construction Details					
Total Well Depth	23.4'	Riser	2.0' stick-up	Screened Interval	3.4'-23.4'
Borehole Diameter	11 5/8"	Well Diameter	2"	Static Water Level	4.5'

Method of Development: Hand Pump/ Actuator
Pumping Rate:
Pump Depth(s): screen swabbed, then pumped from near bottom of the well
Development Start Time: 6/12/96 @ 1500 hrs Stop time: 6/13/96 @ 1530 hrs

Physical Appearance:
Initial dark brown, silty
During yellow, cloudy
Final clear

Well Volume (including filter pack): 25 gallons

Field Analysis	Volume #1	Volume # 2	Volume # 3	Volume # 4	Volume #5
Time	6/12@1630	6/13@0945	6/13@1130	6/13@1342	6/13@1530
Turbidity (NTU)	not taken	92.5	31.4	26.4	38.6
Conductivity (μs/cm)	2.40×10^2	2.91×10^2	1.99×10^2	1.70×10^2	1.52×10^2
pH	7.58	7.98	7.52	7.66	7.37
Temperature (°F)	63.8	61.6	63.6	64.7	63.9

Total Quantity of Water Removed: 125 gallons
Method of Water Disposal: water was disposed of atleast 50' away from well onto ground
Sample Jar Collected:

Comments: This well was developed over the amt. of time allotted and was clear to the naked eye upon completion.

Well # C-11

MONITORING WELL DEVELOPMENT RECORD

Project: Adelphi Laboratory Center - RI
Location: Adelphi, MD
Inspector: Brock/ Dimbers
Installation Date: 5/21/96 Development Date: 5/24/96, 5/25/96, 6/14/96

Well Construction Details					
Total Well Depth	74.6'	Riser	2.0' stick-up	Screened Interval	64.6'-74.6'
Borehole Diameter	5 5/8"	Well Diameter	2"	Static Water Level	20.1' (5/30/96)

Method of Development: bailer
Pumping Rate:
Pump Depth(s): screen swabbed, then bailed from near bottom of the well
Development Start Time: 6/4/96 @ 1355 hrs Stop time: 6/11/96 @ 1400 hrs

Physical Appearance:
Initial dark brown w/ rock and dust fragments
During dark brown w/ rock and dust fragments
Final dark brown w/ rock and dust fragments

Well Volume (including filter pack): 27 gallons

Field Analysis	Initial	Volume # 1	Volume # 2	Volume # 3	
Time	N/A	5/24	5/25	6/14 @ 0830	
Turbidity (NTU)	N/A	>1000	>1000	>1000	
Conductivity (μs/cm)	N/A	3.22×10^2	1.14×10^2	2.22×10^3	
pH	N/A	6.2	11.4	10.25	
Temperature (°F)	N/A	69.0	68.5	not taken	

Total Quantity of Water Removed: approx. 40 gallons
Method of Water Disposal: water was disposed of atleast 50' away from well onto ground
Sample Jar Collected:

Comments: This well was developed over the amt. of time allotted and still did not clear up. Had to stop developing due to time constraint. The well volume was calculated using a 20.1' length of water in well measured on 5/30/96. Very little development could be done on this well due to a tremendously slow recharge rate. The well recharged only 2/3 of the amount of water noted on well construction diagram over a period of 2 weeks. The screen is placed in highly competent, very minimally fractured rock.

Well # C-12

MONITORING WELL DEVELOPMENT RECORD

Project: Adelphi Laboratory Center - RI
Location: Adelphi, MD
Inspector: Brock/ Dimbers
Installation Date: 5/22/96 Development Date: 5/25/96, 5/28/96, 6/14/96

Well Construction Details					
Total Well Depth	25.3'	Riser	2.0' stick-up	Screened Interval	5.3'-25.3'
Borehole Diameter	11 5/8"	Well Diameter	2"	Static Water Level	10.3'

Method of Development: Hand Pump/ Actuator
Pumping Rate:
Pump Depth(s): screen swabbed, then pumped from near bottom of the well
Development Start Time: 5/25/96 @ 0845 hrs Stop time: 6/14/96 @ 1330 hrs

Physical Appearance:
Initial brown, silty
During cloudy
Final clear

Well Volume (including filter pack): 18 gallons

Field Analysis	Volume #1	Volume # 2	Volume # 3	Volume # 4	Volume # 5
Time	5/25 @ 0845	5/25 @ 1030	5/25 @ 1100	5/28 @ 1530	5/28 @ 1650
Turbidity (NTU)	>1000	>1000	>1000	>1000	189
Conductivity (μs/cm)	1.81×10^2	1.65×10^2	1.65×10^2	3.27×10^2	1.55×10^2
pH	8.40	8.20	7.80	7.60	6.80
Temperature (°F)	61.8	59.4	59.6	58.0	57.1

Total Quantity of Water Removed: 122 gallons
Method of Water Disposal: water was disposed of atleast 50' away from well onto ground
Sample Jar Collected:

Comments: This well was developed over the amt. of time allotted and cleared up.

Well # C-12

MONITORING WELL DEVELOPMENT RECORD

Project: Adelphi Laboratory Center - RI
Location: Adelphi, MD
Inspector: Brock/ Dimbers
Installation Date: 5/22/96 Development Date: 5/25/96, 5/28/96, 6/14/96

Well Construction Details					
Total Well Depth	25.3'	Riser	2.0' stick-up	Screened Interval	5.3'-25.3'
Borehole Diameter	11 5/8"	Well Diameter	2"	Static Water Level	10.3'

Method of Development: Hand Pump/ Actuator
Pumping Rate:
Pump Depth(s): screen swabbed, then pumped from near bottom of the well
Development Start Time: 5/25/96 @ 0845 hrs Stop time: 6/14/96 @ 1330 hrs

Physical Appearance:
Initial brown, silty
During cloudy
Final clear

Well Volume (including filter pack): 18 gallons

Field Analysis	Volume #5	Final			
Time	5/28 @ 1710	6/14 @ 1330			
Turbidity (NTU)	197	16.8			
Conductivity (μs/cm)	1.60×10^2	2.65×10^2			
pH	6.60	8.59			
Temperature (°F)	56.5	68.4			

Total Quantity of Water Removed:
Method of Water Disposal:
Sample Jar Collected:

Comments:

Well # C-13

MONITORING WELL DEVELOPMENT RECORD

Project: Adelphi Laboratory Center - RI
Location: Adelphi, MD
Inspector: Brock/ Dimbers
Installation Date: 6/22/96 Development Date: 6/24/96

Well Construction Details					
Total Well Depth	11.0'	Riser	0.4' BGS	Screened Interval	1.0'-11.0'
Borehole Diameter	11 5/8"	Well Diameter	2"	Static Water Level	3.0'

Method of Development: bailer
Pumping Rate:
Pump Depth(s):
Development Start Time: 6/24/96 @ 0900 hrs Stop time: 6/24/96 @ 1340 hrs

Physical Appearance:
Initial clear
During cloudy (after surging well using bailer and rope)
Final clear

Well Volume (including filter pack): *11 gallons*

Field Analysis	Initial	Volume # 1	Volume # 2		
Time	N/A	6/24 @ 0900	6/24 @ 1340		
Turbidity (NTU)	N/A	491	7.26		
Conductivity (µs/cm)	N/A	5.93×10^3	4.60×10^3		
pH	N/A	10.51	10.45		
Temperature (°F)	N/A	68.7	73.2		

Total Quantity of Water Removed: 10 gallons
Method of Water Disposal: water was disposed of atleast 50' away from well onto ground
Sample Jar Collected:

Comments: This well is screened in decomposed rock that when split spoon sampled showed high blow counts. No water was encountered or introduced when drilling or even when installing the well. Only some moisture was seen on the augers. Water was measured at 3.0' after a 48 hr period. The hole was bailed dry when developing. Recharge rate was very slow. There was virtually no sediment inside the well. What was there was circulated by lifting the bailer up and down and then removing the sediment, along with the water, inside of the bailer.

Date: 29 APR 97

Well I.D. C-14

MONITORING WELL DEVELOPMENT RECORD

Project: Remedial Investigation at the Building 500 Area

Location: Adelphi, MD

Name (printed): Chuck Kyle Signature:

Method of Development (i.e. swabbing and surging, overpumping, etc): Aardvark Aqua Developer

Pumping Rate: approx. 1.5 gpm Pump Depth(s): 100 ft

Well Volume Calculation:

$$V = 0.163 [(r_c^2 * h) + (r_c^2 * h)]$$

V = 20.4 + 34.6 = 55 gal

V = Volume (gallons)

r_c = Well casing radius (inches)

r_b = Boring radius (inches)

h = height of water column = d - w (feet)

Dimensions from well construction diagram:	
Well Casing Radius (r_c)	1.89, 2
Boring Radius (r_b)	

Measurements upon opening well cap:	
PID Reading	
Static Water Level (w)	13.8 ft
Well Depth Sounding (d)	101 ft

Date	Time	Cumulative Volume Removed	Turbidity (NTUs)	Temp. (°C)	pH	Conductivity (micro-mhos/cm)	DO (ppm)
4/29	0815	start	>1000	55.2	6.32	11.54	
4/29	0900	70 gal	>1000	54.0	6.31	10.12	
4/29	1200	140 gal	303	67.1	6.34	7.89	
4/29	1430	210 gal	80.4	67.4	7.91	5.40	
4/30	0830	250 gal	94.8	50.2	7.78	4.84	
4/30	1300	280 gal	9.78	52.2	7.81	4.90	

Physical Appearance:

Initial Medium gray

During Very light gray to clear

Final Clear

Well Depth Sounding:

Initial

During

Final

Method of Water Disposal: Drummed

Comments:

Date: 24 APR 97

Well I.D. **C-15**

MONITORING WELL DEVELOPMENT RECORD

Project: Remedial Investigation at the Building 500 Area
Location: Adelphi, MD
Name (printed): Chuck Kyle Signature:

Method of Development (i.e. swabbing and surging, overpumping, etc): Aardvark Aqua Developer

Pumping Rate: approx. 1 gpm Pump Depth(s): 100 ft

Well Volume Calculation:

$$V = 0.163\,[(r_c{}^2 * h) + (r_c{}^2 * h)]$$

V = 23.3 + 25.4 = 48.7 gal

V = Volume (gallons)
r_c = Well casing radius (inches)
r_b = Boring radius (inches)
h = height of water column = d - w (feet)

Dimensions from well construction diagram:	
Well Casing Radius (r_c)	1.89, 2
Boring Radius (r_b)	

Measurements upon opening well cap:	
PID Reading	
Static Water Level (w)	22.85 ft
Well Depth Sounding (d)	100.1 ft

Date	Time	Cumulative Volume Removed	Turbidity (NTUs)	Temp. (°C)	pH	Conductivity (micro-mhos/cm)	DO (ppm)
4/24	0910	start	696	65.6	6.01	2.35	
4/24	1300	70 gal	190	66.1	6.04	2.16	
4/24	1510	90 gal	102	67.5	6.05	2.08	
4/25	0720	120 gal	17.2	54.8	6.39	2.41	
4/25	0900	140 gal	6.19	55.1	6.36	2.38	
4/25	1200	210 gal	5.02	55.6	6.40	2.32	
4/25	1400	280 gal	1.77	56.1	6.38	2.28	

Physical Appearance:
Initial Medium gray
During Light gray to clear
Final Clear

Well Depth Sounding:
Initial
During
Final

Method of Water Disposal: Drummed

Comments:

Prince George's County
Health Department

Division of Environmental Health
Water Quality & Septic Systems
9201 Basil Court - Suite 318
Largo, Maryland 20774-5310

21283-1715

To: Ms. Michelle Brock, Army Corp of Engineers
From: Tom Devlin, Prince George's County Health Dept.
Re: Wells on Powder Mill Rd

Here is the data you requested regarding private wells on the properties listed below.

3010 Powder Mill Rd- no data on well, but a site inspection done in 1985 indicated that there is a deep well on the lot.

3030 Powder Mill Rd- Tag# PG-72-0029; drilled March 17,1972.
Top casing diameter-6".
Cement grouted from 0 to 20'.
Total well depth-205'.
HO screen from 20' to 205'.

3118 Powder Mill Rd- see attached well completion report.

AUG-26-'96 MON 14:33 ID: TEL NO:

STATE OF MARYLAND

DEPARTMENT OF WATER RESOURCES

STATE OFFICE BLDG., ANNAPOLIS, MARYLAND 21401

WELL COMPLETION REPORT

FILL IN THIS FORM COMPLETELY

9505

41773

March 17 197[illegible]

DEPTH OF WELL 205

PG 72-0089

[redacted]

WELL LOG

DESCRIPTION	FROM	TO	WATER BEARING
Yellow Shale	1	10	110
			80
Yellow Sand Stone	10	40	
Gray	40	80	
Granet			

To: Michelle Brock

From: Denise Swatzbaugh MDE

GROUTING RECORD

DEPTH OF GROUT SEAL

CASING RECORD

6 20

OTHER CASING

SCREEN RECORD

H 0 20 205

PUMPING TEST

3

3 gal

Baller

WATER LEVEL

40

200

TYPE OF PUMP USED

PUMP INSTALLED

CASING HEIGHT

LOCATION OF WELL ON LOT

Well 10

10

Hse

CIRCLE APPROPRIATE BOXES

Harry Green

Harry Green

THIS NUMBER IS TO BE PUNCHED IN COLS. 3-8 ON ALL CARDS)

(DEM/ USE ONLY)

WELL COMPLETION REPORT
FILL IN THIS FORM COMPLETELY
PLEASE PRINT OR TYPE 190719

THIS REPORT MUST BE SUBMITTED WITHIN 45 DAYS AFTER WELL IS COMPLETED

COUNTY NUMBER

ST/CO USE ONLY
DATE Received: MAR 14 1990

DATE WELL COMPLETED: 0 2 0 1 9 0

Depth of Well: 2 0 0

PERMIT NO. FROM "PERMIT TO DRILL WELL": PG-88-0587

OWNER (b) (6), (b) (9) [redacted]

STREET OR R [redacted]

SUBDIVISION Walt Brush Homes   TOWN Adelphi

SECTION Hemlock Hills   LOT Parcel #1

WELL LOG

Not required for driven wells

STATE THE KIND OF FORMATIONS PENETRATED, THEIR COLOR, DEPTH, THICKNESS AND IF WATER BEARING

DESCRIPTION (Use additional sheets if needed)	FEET FROM	FEET TO	Check if water bearing
Topsoil	0	6"	
coarse clay/e sand, dark gray	6"	24'	
Dirty black cemented sand	24'	39'	✓
Gray Rock	39'	106'	
White Rock	106'	133'	
Green Rock	133'	139'	✓
Gray Rock	139'	183'	
Gray/Green Rock	183'	196'	✓
Gray-black Rock	196'	200'	

CIRCLE APPROPRIATE LETTER

A A WELL WAS ABANDONED AND SEALED WHEN THIS WELL WAS COMPLETED

E ELECTRIC LOG OBTAINED

P TEST WELL CONVERTED TO PRODUCTION WELL

I HEREBY CERTIFY THAT THIS WELL HAS BEEN CONSTRUCTED IN ACCORDANCE WITH COMAR 26.04.04 - WELL CONSTRUCTION AND IN CONFORMANCE WITH ALL CONDITIONS STATED IN THE WELL CONSTRUCTION PERMIT, AND THAT THE INFORMATION GIVEN HEREIN IS ACCURATE AND COMPLETE TO THE BEST OF MY KNOWLEDGE

DRILLERS LICENSE NO. MWD 487

Warren E. Black
DRILLERS SIGNATURE
(MUST MATCH SIGNATURE ON APPLICATION)

SITE SUPERVISOR (sign) of driller or journeyman responsible for sitework if different from permittee

GROUTING RECORD

WELL HAS BEEN GROUTED (Circle Appropriate Box): yes (Y) no N

TYPE OF GROUTING MATERIAL: CEMENT (CM) BENTONITE CLAY BC

NO. OF BAGS 13   NO. OF POUNDS 1222

GALLONS OF WATER 72

DEPTH OF GROUT SEAL (to nearest foot): from TOP ft. to 43 ft. (enter 0 if from surface)

CASING RECORD

casing types: insert appropriate code below — ST STEEL, CO CONCRETE, PL PLASTIC, OT OTHER

MAIN CASING TYPE: PL   Nominal diameter top (main) casing (nearest inch): 06   Total depth of main casing (nearest foot): 43

OTHER CASING (if used): diameter inch; depth (feet) from, to

SCREEN RECORD

screen type or open hole: insert appropriate code below — ST STEEL, BR BRASS BRONZE, HO OPEN HOLE, PL PLASTIC, OT OTHER

C 2

HO   DEPTH (nearest ft.) 43   200

DIAMETER OF SCREEN (NEAREST INCH)

from to

GRAVEL PACK

IF WELL DRILLED WAS FLOWING WELL INSERT F IN BOX 68

DEP USE ONLY
(NOT TO BE FILLED IN BY DRILLER)

TELESCOPE CASING   LOG INDICATOR   OTHER DATA

C 3

PUMPING TEST

HOURS PUMPED (nearest hour) 02

PUMPING RATE (gal. per min., to nearest gal.) 5

METHOD USED TO MEASURE PUMPING RATE Sub. Pump

WATER LEVEL (distance from land surface)

BEFORE PUMPING 16

WHEN PUMPING 143

TYPE OF PUMP USED (for test): A air, P piston, T turbine, C centrifugal, R rotary, O other (describe below), J jet, (S) submersible

PUMP INSTALLED

DRILLER WILL INSTALL PUMP (CIRCLE) (YES or NO) YES (NO)

IF DRILLER INSTALLS PUMP, THIS SECTION MUST BE COMPLETED FOR ALL WELLS EXCEPT HOME USE

TYPE OF PUMP INSTALLED PLACE (A,C,J,P,R,S,T,O) IN BOX - SEE ABOVE

CAPACITY GALLONS PER MINUTE (to nearest gallon)

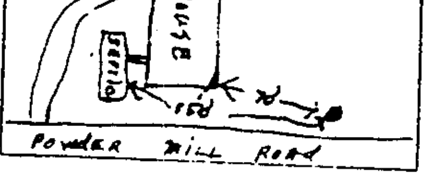
PUMP HORSE POWER

PUMP COLUMN LENGTH (nearest ft.)

CASING HEIGHT (circle appropriate box and enter casing height): + above, − below LAND SURFACE (nearest foot)

LOCATION OF WELL ON LOT

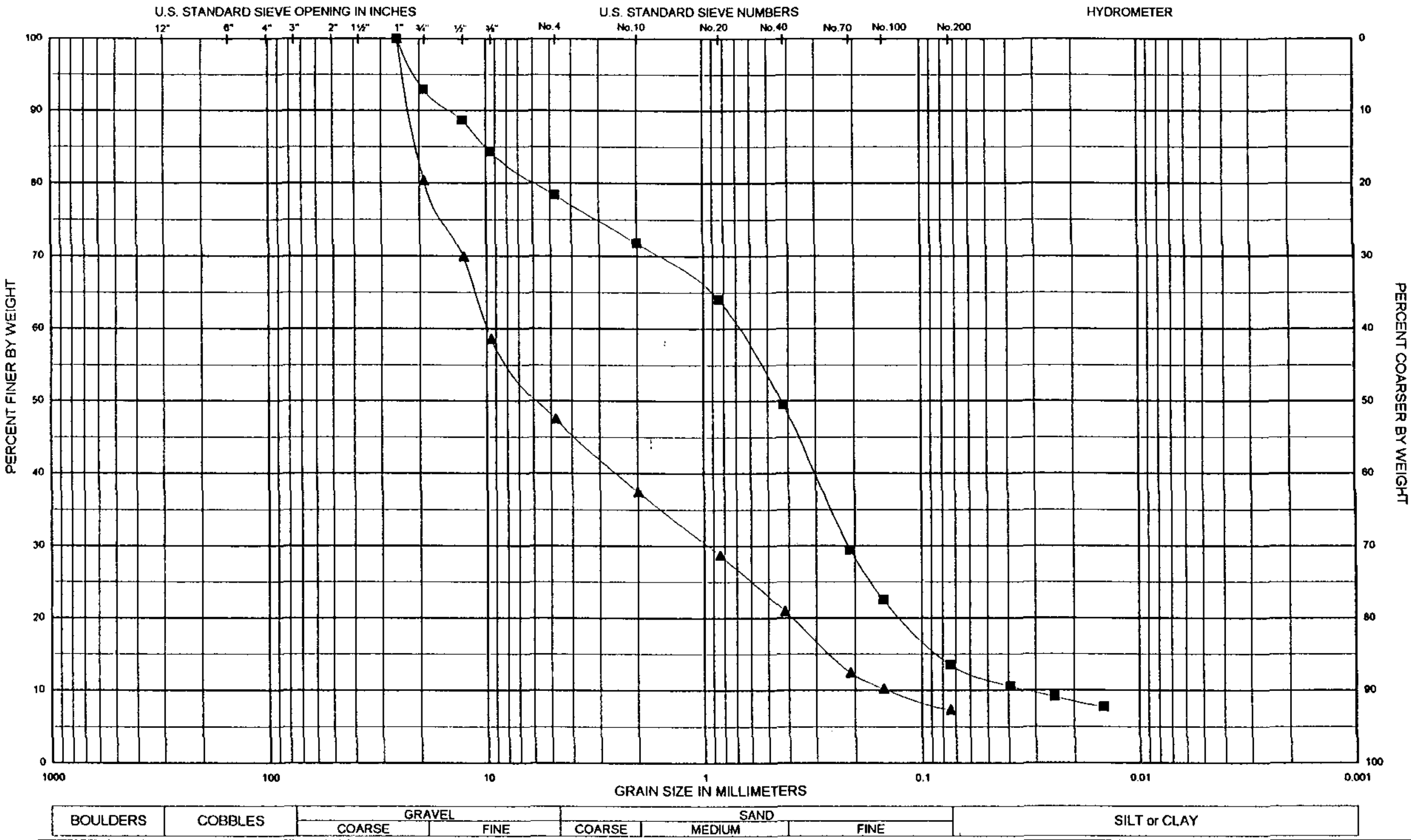
SHOW PERMANENT STRUCTURE SUCH AS BUILDINGS, SEPTIC TANKS AND/OR LANDMARKS AND INDICATE NOT LESS THAN TWO DISTANCES (MEASUREMENTS TO WELL)



ORIGINAL

Appendix C

Geotechnical Data



Legend	Sample No.	Depth (ft)	Classification		Nat w%	LL	PL	PI
—■—	Jar-8,9*	20.0-21.5	Clayey sand with gravel	(SC)	13.7	——	——	——
	"	"	* L.O.I. = 0.8% - Inorganic					
—▲—	Jar-11**	30.0-31.5	Poorly graded gravel with silt and sand	(GP-GM)	10.9	——	——	——
	"	"	** L.O.I. = 1.0% - Inorganic					

PROJECT: Adelphi Laboratory Center - RI

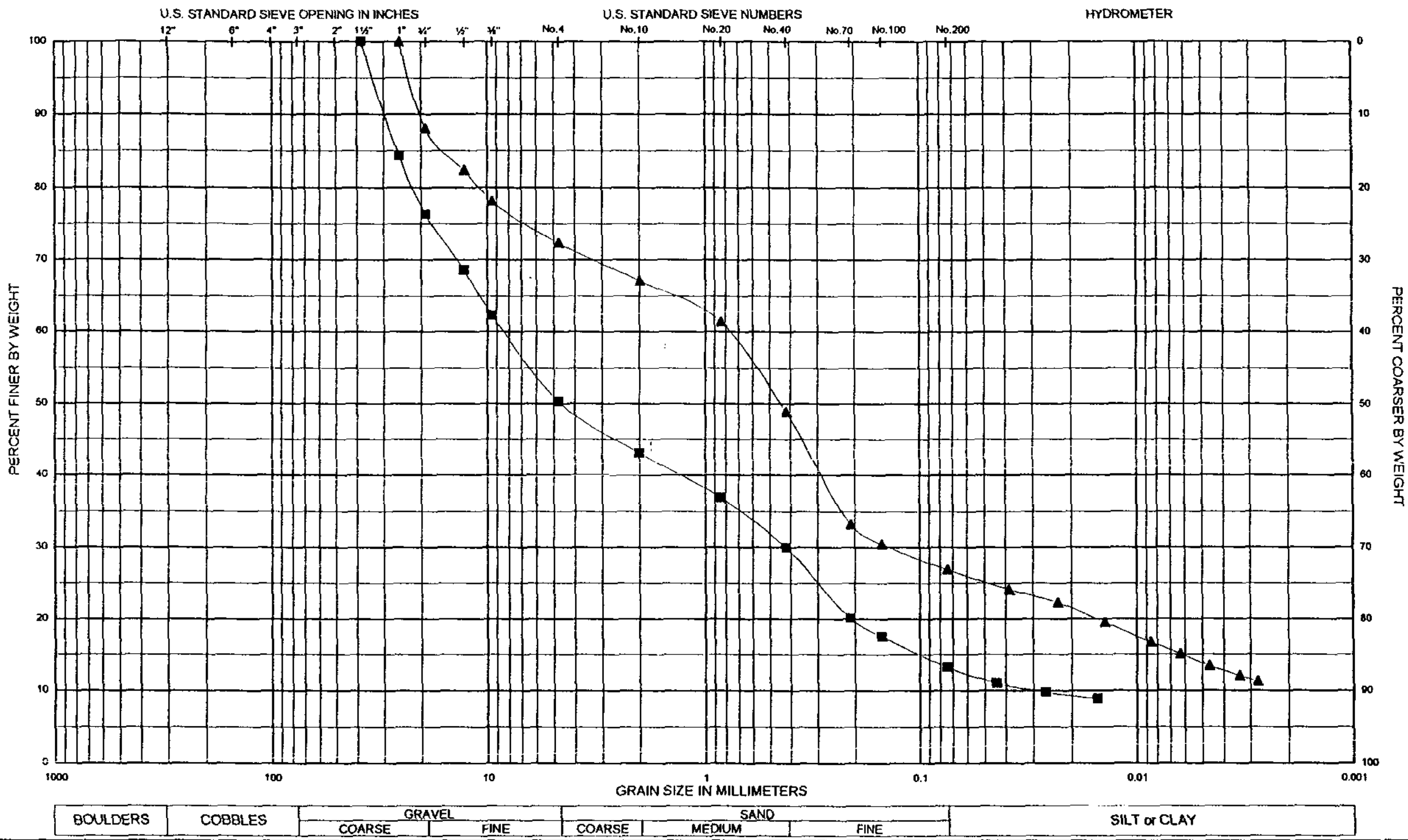
AREA: Adelphi, MD

Boring No.: C-5

DATE: Aug 1996

ENG FORM 2087

GRADATION CURVES



Legend	Sample No.	Depth (ft)	Classification		Nat w%	LL	PL	PI
—■—	Jar-5*	10.0-11.5	Clayey gravel with sand	(GC)	6.8	——	——	——
	"	"	* L.O.I. = 1.9% - Inorganic					
—▲—	Jar-8**	25.0-26.5	Clayey sand with gravel	(SC)	12.4	——	——	——
	"	"	** L.O.I. = 2.1% - Inorganic					

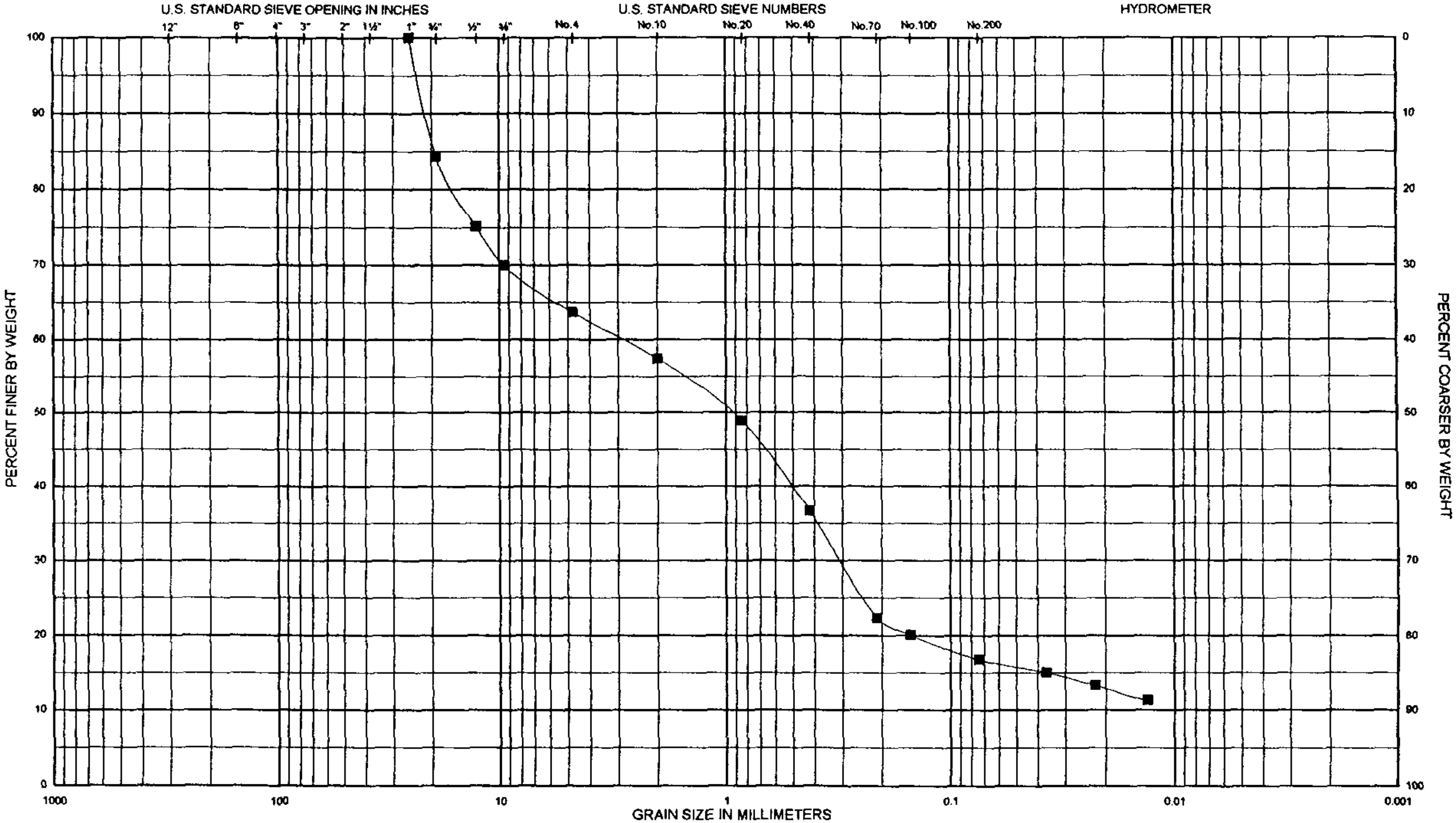
ENG FORM 2087 — **GRADATION CURVES**

PROJECT: Adelphi Laboratory Center - RI

AREA: Adelphi, MD

Boring No.: C-6

DATE: Aug 1996



BOULDERS	COBBLES	GRAVEL COARSE	GRAVEL FINE	SAND COARSE	SAND MEDIUM	SAND FINE	SILT or CLAY

Legend	Sample No.	Depth (ft)	Classification	Nat w%	LL	PL	PI
—■—	Jar-8*	20.0-21.5	Clayey sand with gravel (SC)	15.3	——	——	——
	"	"	* L.O.I. = 0.6% - Inorganic				

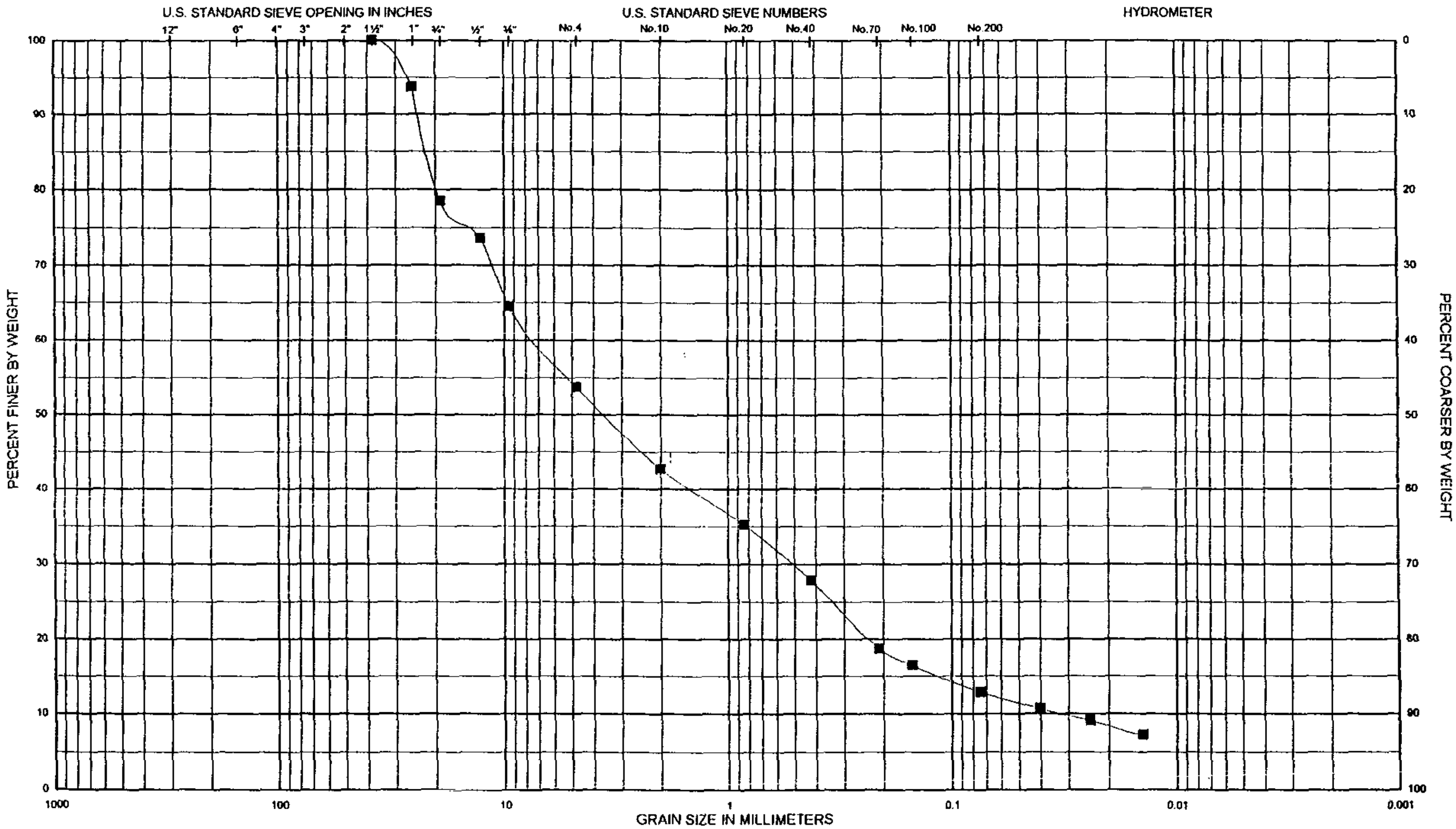
PROJECT: Adelphi Laboratory Center - RI

AREA: Adelphi, MD

Boring No.: C-7

DATE: Sep 1996

ENG FORM 2087 — **GRADATION CURVES**



BOULDERS	COBBLES	GRAVEL		SAND			SILT or CLAY
		COARSE	FINE	COARSE	MEDIUM	FINE	

Legend	Sample No.	Depth (ft)	Classification		Nat w%	LL	PL	PI
—■—	Jar-9*	15.0-16.5	Clayey gravel with sand	(GC)	7.0	——	——	——
	"	"	* L.O.I. = 0.2% - Inorganic					

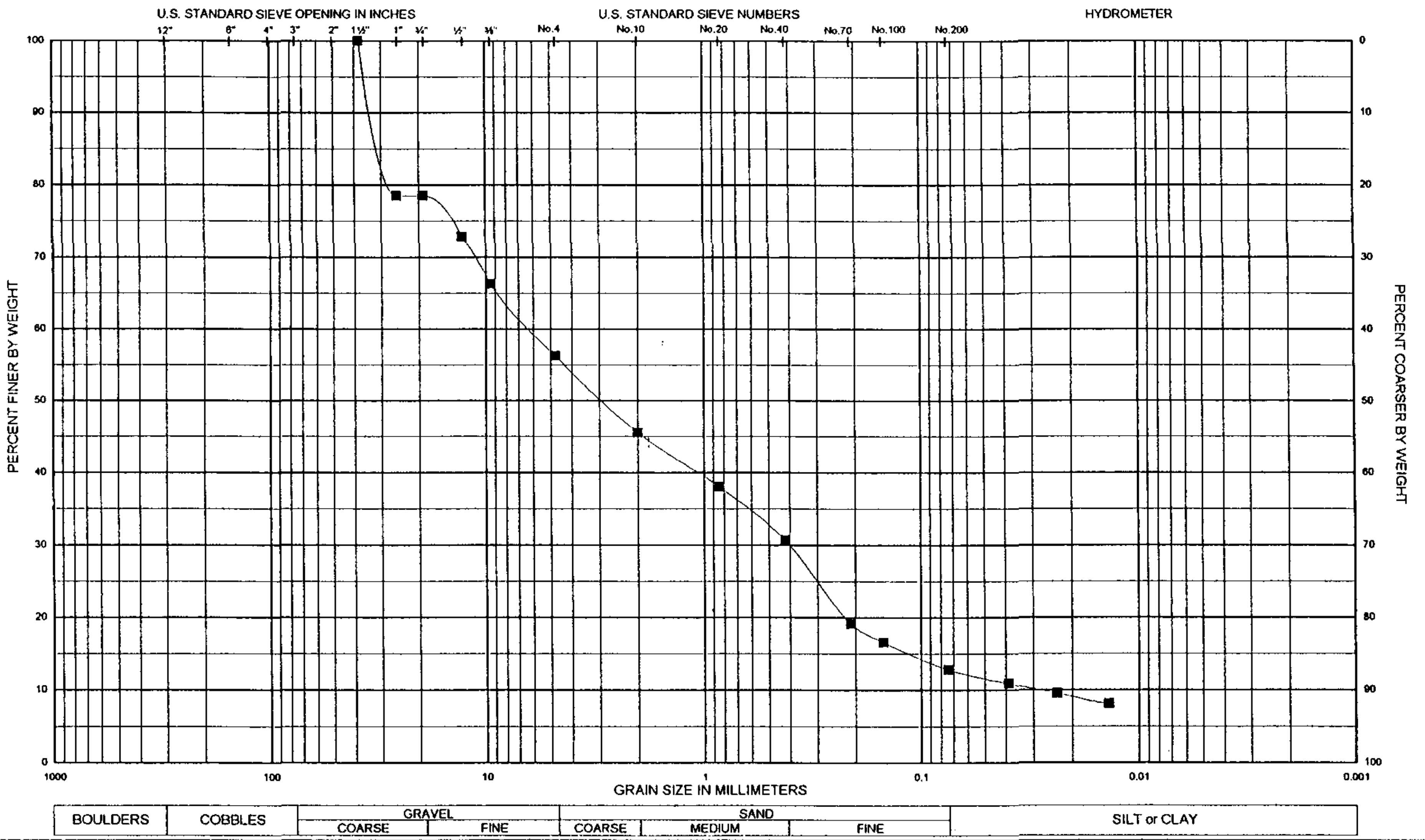
PROJECT: Adelphi Laboratory Center - RI

AREA: Adelphi, MD

Boring No.: C-8

DATE: Aug 1996

ENG FORM 2087 **GRADATION CURVES**



Legend	Sample No.	Depth (ft)	Classification	Nat w%	LL	PL	PI
—■—	Jar-5*	12.5-14.0	Clayey gravel with sand (GC)	12.3	—	—	—
	"	"	* L.O.I. = 0.4% - Inorganic				

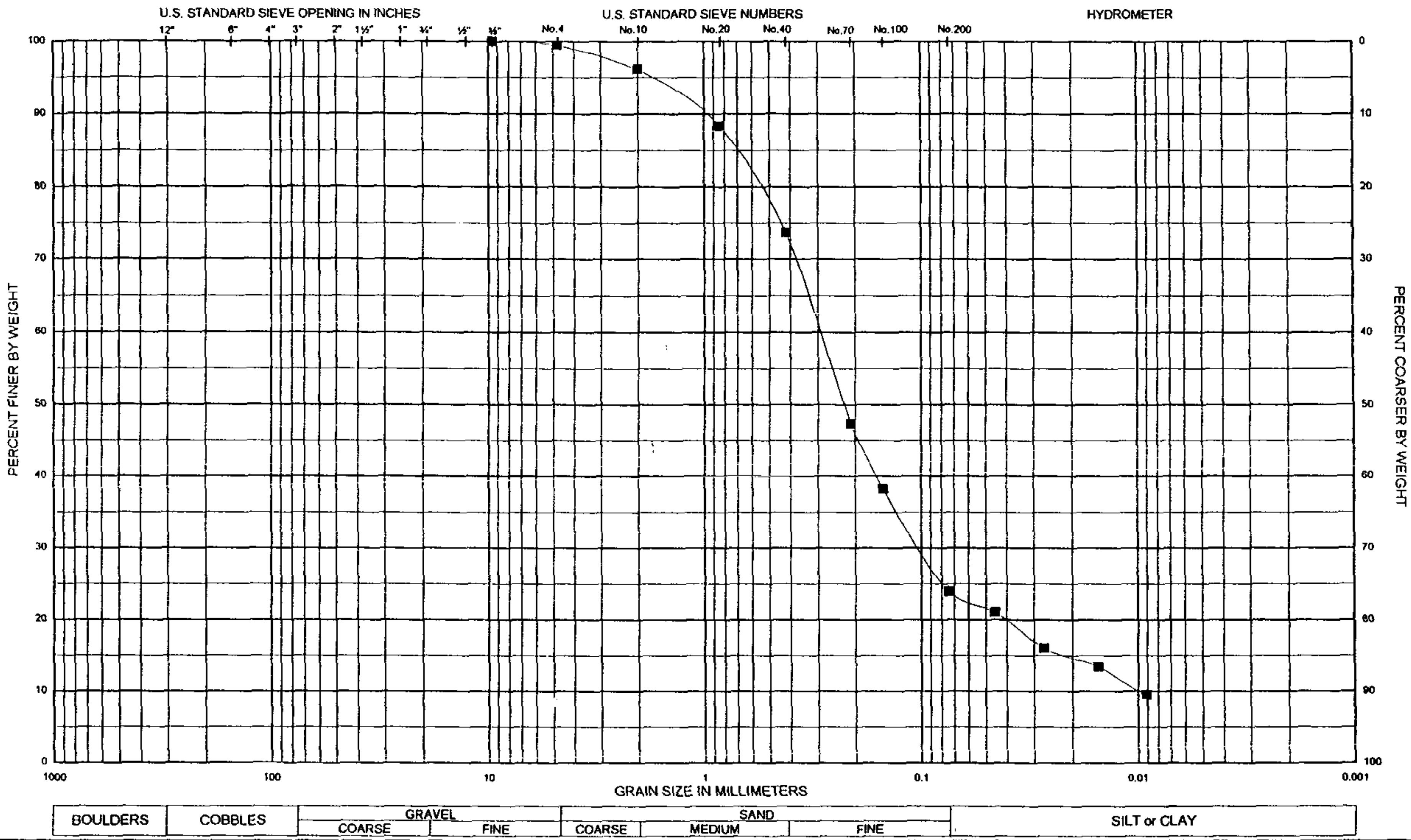
PROJECT: Adelphi Laboratory Center - RI

AREA: Adelphi, MD

Boring No.: C-9

DATE: Aug 1996

ENG FORM 2087 **GRADATION CURVES**



Legend	Sample No.	Depth (ft)	Classification	Nat w%	LL	PL	PI
—■—	Jar-7*	15.0-16.5	Silty sand (SM)	12.2	——	——	——
	"	"	* L.O.I. = 3.5% - Inorganic				

PROJECT: Adelphi Laboratory Center - RI

AREA: Adelphi, MD

Boring No.: C-10

DATE: Aug 1996

ENG FORM 2087 **GRADATION CURVES**

VISUAL-MANUAL CLASSIFICATIONS

PROJECT: Adelphi Laboratory Center
Remedial Investigation at Bldg. 500
AREA: Adelphi, MD

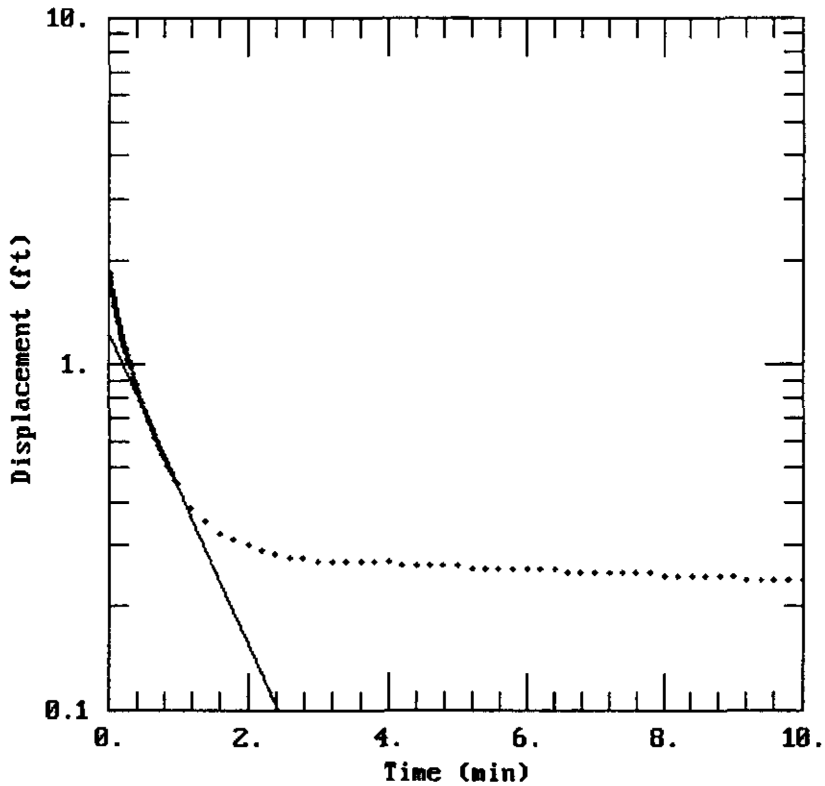
DATE: Jun. 1997
Classified by: WRS

Sample No.	Depth (ft.)	Visual Classification	Symbol
C-14			
Jar-1	35.0-36.5	Moist, light greenish gray & olive yellow, clayey sand[1] (tr. rock)	(SC)
Jar-2	40.0-41.07	Slightly moist, light olive gray & black, clayey sand[1]	(SC)
Jar-3	45.0-45.65	Slightly moist, light olive gray & black, clayey sand[1]	(SC)
Jar-4	50.0-50.67	Dry, pale yellow & black, clayey sand[1]	(SC)
C-15			
Jar-1	35.0-36.5	Slightly moist, reddish yellow & light gray, clayey sand[1] (tr. rock)	(SC)
Jar-2	40.0-41.5	Slightly moist, dark gray, olive gray & black silty clayey sand[1]	(SC-SM)
Jar-3	45.0-46.5	Slightly moist, gray & olive gray clayey sand[1]	(SC)
Jar-4	50.0-50.7	Slightly moist, gray & olive gray clayey sand[1]	(SC)
		[1] Micaceous sand (saprolite)	

Appendix D

Slug Test Data

ALC - Slug Testing Data



DATA SET:
C-6.AQT
09/06/96

AQUIFER MODEL:
Unconfined

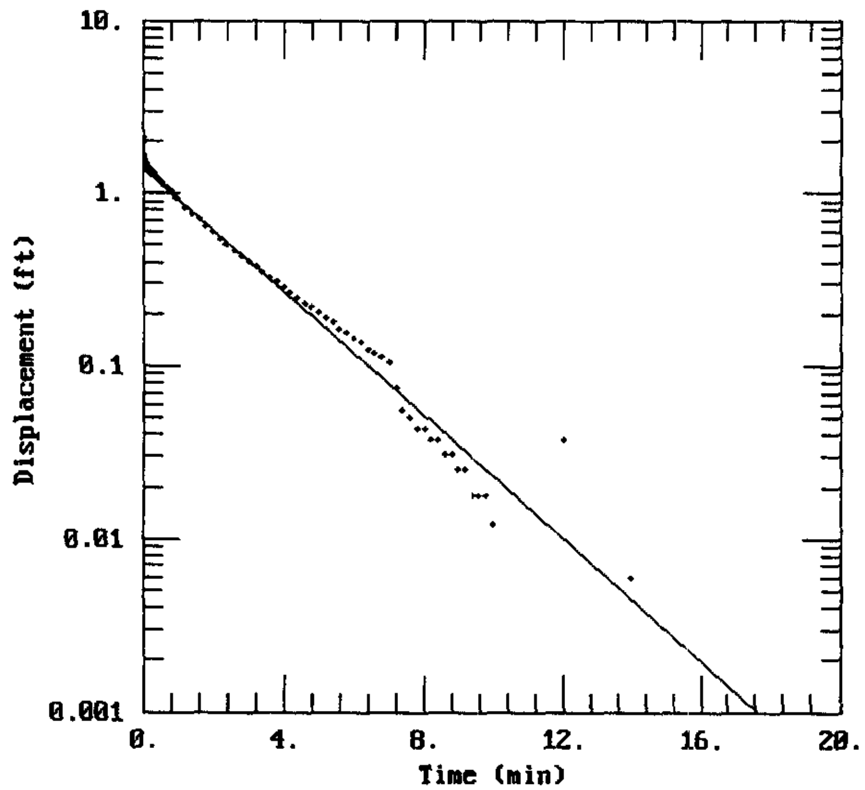
SOLUTION METHOD:
Bouwer-Rice

TEST DATA:
H0= 1.83 ft
r_c= 0.083 ft
r_w= 0.48 ft
L = 20. ft
b = 50. ft
H = 14.1 ft

PARAMETER ESTIMATES:
K = 6.183 ft/day
y0 = 1.226 ft

AQTESOLV

ALC - Slug Testing Data



DATA SET:
C-7.AQT
09/03/96

AQUIFER MODEL:
Unconfined

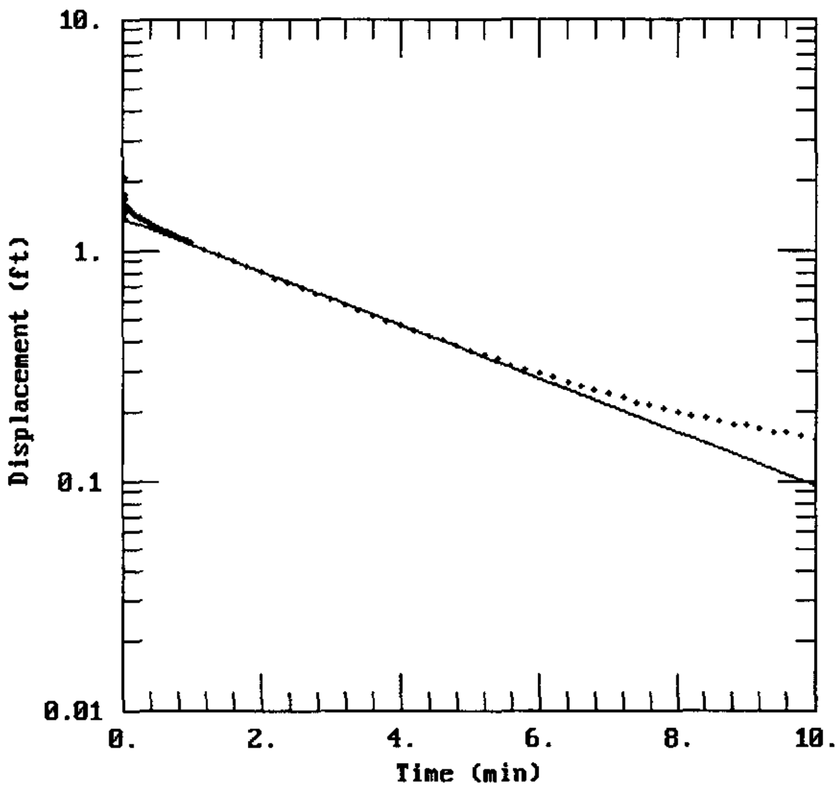
SOLUTION METHOD:
Bouwer-Rice

TEST DATA:
H0= 2.105 ft
r_c= 0.083 ft
r_w= 0.48 ft
L = 20. ft
b = 50. ft
H = 18.63 ft

PARAMETER ESTIMATES:
K = 2.631 ft/day
y0 = 1.39 ft

AQTESOLV

ALC - Slug Testing Data



DATA SET:
C-8.AQT
09/03/96

AQUIFER MODEL:
Unconfined

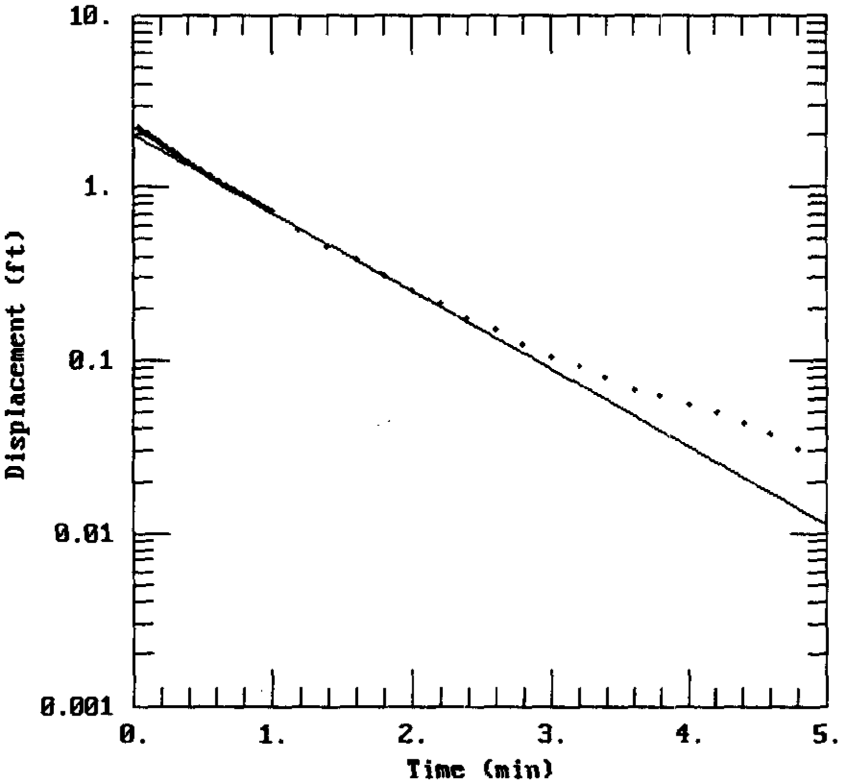
SOLUTION METHOD:
Bouwer-Rice

TEST DATA:
H0= 2.087 ft
r_c= 0.083 ft
r_w= 0.485 ft
L = 20. ft
b = 50. ft
H = 18.72 ft

PARAMETER ESTIMATES:
K = 1.744 ft/day
y0 = 1.38 ft

AQTESOLV

ALC - Slug Testing Data



DATA SET:
C-12.AQT
09/03/96

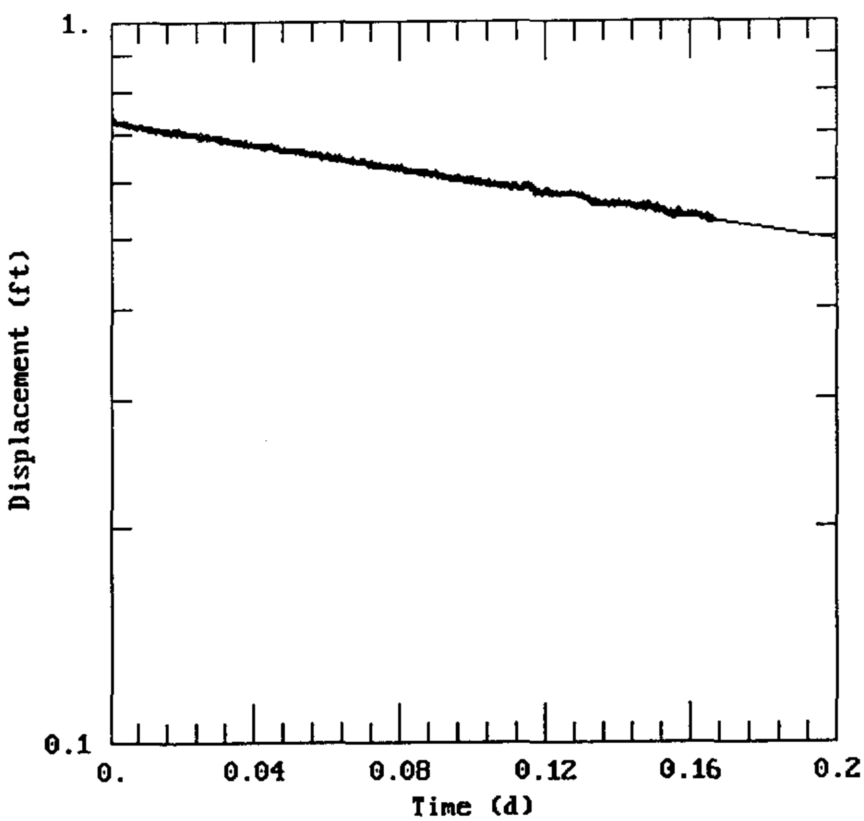
AQUIFER MODEL:
Unconfined

SOLUTION METHOD:
Bouwer-Rice

TEST DATA:
H0= 2.224 ft
r_c= 0.083 ft
r_w= 0.48 ft
L = 20. ft
b = 50. ft
H = 11.76 ft

PARAMETER ESTIMATES:
K = 6.02 ft/day
y0 = 2.01 ft

AQTESOLV



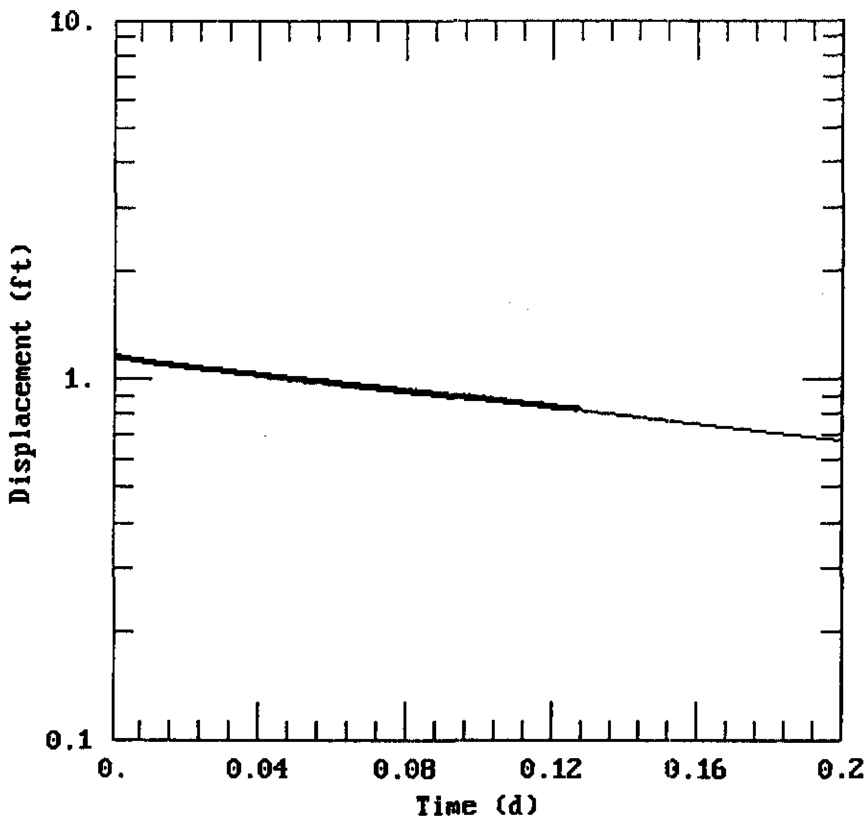
DATA SET:
C14.DAT
07/15/97

AQUIFER MODEL:
Unconfined

SOLUTION METHOD:
Bouwer-Rice

TEST DATA:
H0= 0.73 ft
r_c= 0.158 ft
r_w= 0.158 ft
L = 35. ft
b = 85. ft
H = 85. ft

PARAMETER ESTIMATES:
K = 0.003281 ft/d
y0 = 0.7271 ft



DATA SET:
C15.DAT
07/15/97

AQUIFER MODEL:
Unconfined

SOLUTION METHOD:
Bouwer-Rice

TEST DATA:
H0= 1.2 ft
r_c= 0.158 ft
r_w= 0.158 ft
L = 40. ft
b = 94. ft
H = 94. ft

PARAMETER ESTIMATES:
K = 0.004014 ft/d
y0 = 1.144 ft

Appendix E

Field Permeability Test Data

CONSTANT HEAD FIELD PERMEABILITY TEST
FOR HOLLOW STEM AUGER BORINGS

Project Data - Test 1

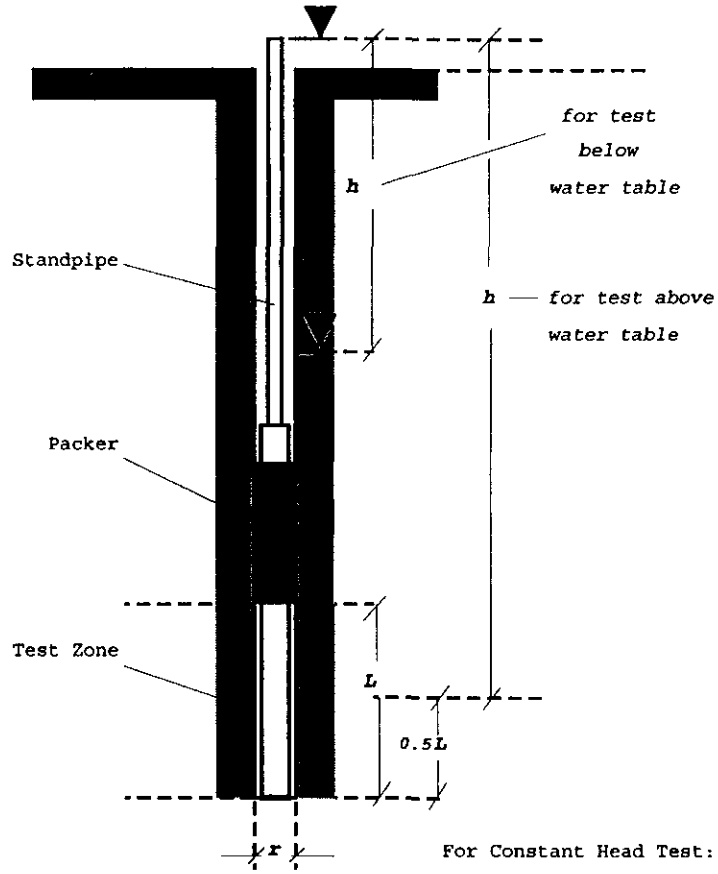
Project:	Adelphi Laboratory Center-RI	Date:	5/18/96
Location:	Adelphi, MD		
Weather Conditions:	Cloudy, Overcast, 70F		

Test Set Up

Borehole Number:	C-9	Length of Probe (total):	15.58
Depth Top of Test Zone:	10.33	Measured Stick-up:	3.75
Bottom of Test Zone:	11.83	Test above GW Level ?:	below
Test Length *L* (feet)	[redacted]	Static Water Level:	9.2
Test radius *r* (inches)	[redacted]	Water Head *h* (feet):	[redacted]
Flow measurements by:		Remarks:	test interval
calibrated 55 gallon drum,			soil-moist, tan clayey
			SAND w/ gravel

Flow measured in gallons				
Trial No.	V (gal)	T (min)	q (gpm)	[redacted]
1	1.30	10.00	0.13	
2	0.60	10.00	0.06	
3	0.75	10.00	0.08	
avg	0.88	10.00	0.09	

Flow measured in ml's or cc's				
Trial No.	V (ml)	T (min)	q (ml/sec)	[redacted]
1	4920.00	10.00	8.20	
2	2270.00	10.00	3.78	
3	2840.00	10.00	4.73	
avg	3343.33	10	5.57	



For Constant Head Test:

$$k = (q/2\pi Lh)\ \ln(L/r)$$

where:

k = permeability
q = flow in volume per unit time
L = length of test section
h = head of water
r = radius of test section

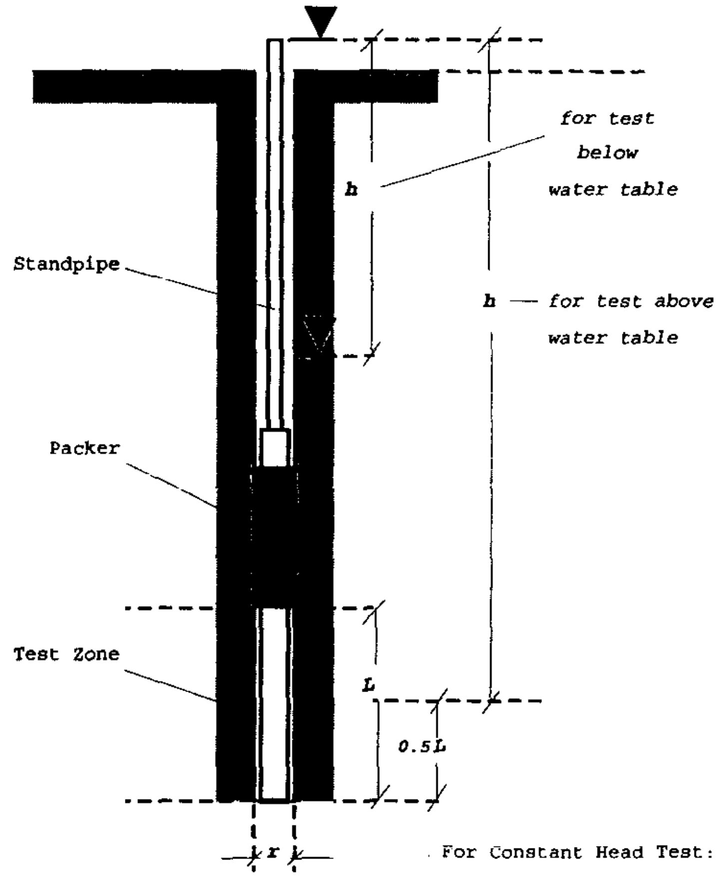
CONSTANT HEAD FIELD PERMEABILITY TEST
FOR HOLLOW STEM AUGER BORINGS

Project Data - Test 2			
Project:	Adelphi Laboratory Center-RI	Date:	5/18/96
Location:	Adelphi, MD		
Weather Conditions:	sunny, clear, hot		

Test Set Up			
Borehole Number:	C-9	Length of Probe (total):	20.75
Depth Top of Test Zone:	18.5	Measured Stick-up:	0.75
Bottom of Test Zone:	20	Test above GW Level ?:	below
Test Length *L* (feet)	[redacted]	Static Water Level:	9.2
Test radius *r* (inches)	[redacted]	Water Head *h* (feet):	[redacted]
Flow measurements by:		Remarks:	test interval
calibrated 55 gallon drum,			soil-dry decomposed rock,
			micaceous, gray silty SAND

Flow measured in gallons				
Trial No.	V (gal)	T (min)	q (gpm)	[redacted]
1	0.20	10.00	0.02	[redacted]
2	0.10	10.00	0.01	[redacted]
3	0.60	10.00	0.06	[redacted]
avg	0.30	10.00	0.03	[redacted]

Flow measured in ml's or cc's				
Trial No.	V (ml)	T (min)	q (ml/sec)	[redacted]
1	750.00	10.00	1.25	[redacted]
2	378.50	10.00	0.63	[redacted]
3	2270.00	10.00	3.78	[redacted]
avg	1132.83	10	1.89	[redacted]



For Constant Head Test:

$$k = (q/2\pi Lh)\ \ln(L/r)$$

where:

- *k* = permeability
- *q* = flow in volume per unit time
- *L* = length of test section
- *h* = head of water
- *r* = radius of test section

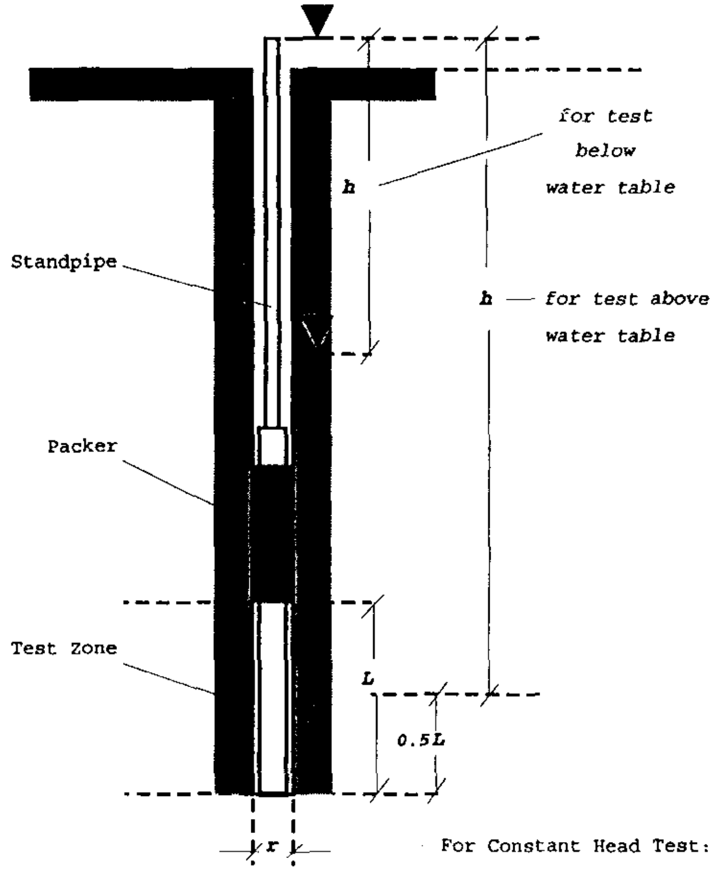
CONSTANT HEAD FIELD PERMEABILITY TEST FOR HOLLOW STEM AUGER BORINGS

Project Data - Test 3			
Project:	Adelphi Laboratory Center-RI	Date:	5/20/96
Location:	Adelphi, MD		
Weather Conditions:	sunny, clear, hot		

Test Set Up			
Borehole Number:	C-9	Length of Probe (total):	25.67
Depth Top of Test Zone:	22.67	Measured Stick-up:	1.5
Bottom of Test Zone:	24.17	Test above GW Level ?:	below
Test Length *L* (feet)	[redacted]	Static Water Level:	9.2
Test radius *r* (inches)	[redacted]	Water Head *h* (feet):	[redacted]
Flow measurements by:		Remarks: test interval	
calibrated 55 gallon drum,		soil-residual soil	

Flow measured in gallons				
Trial No.	V (gal)	T (min)	q (gpm)	[redacted]
1	0.05	10.00	0.01	
2	0.02	10.00	0.00	
3	0.00	10.00	0.00	
avg	0.02	10.00	0.00	

Flow measured in ml's or cc's				
Trial No.	V (ml)	T (min)	q (ml/sec)	[redacted]
1	189.30	10.00	0.32	
2	75.70	10.00	0.13	
3	0.00	10.00	0.00	
avg	88.33	10	0.15	



For Constant Head Test:

$k = (q/2\pi Lh)\ \ln(L/r)$

where:

k = permeability
q = flow in volume per unit time
L = length of test section
h = head of water
r = radius of test section

Appendix J

Response to Comments

Project: NAB9435 - ARL AREA 500
Review: Draft RI Rep

Univ ID # Last Name Ofc Symbol Discipline Page/Sheet # Rm/Detail

==
609937 GROENJES CEMRO-HX-C CHEM 2-2 2.2
-- Routing: MRDHTWRM<--E1ENHCLE Phone: (402) 697-2627

] Augment this section to address the soil samples acquired for chemical
] analysis. This verbiage should identify whether the locations of these
] samples were contingent upon the PID screening results, how many and where
] the samples where taken from, and what analyses were performed.
======= Response: DONE: Where?
] Section has been modified as requested.

==
609938 GROENJES CEMRO-HX-C CHEM 2-3 to 2-4 2.3 to 2.
-- Routing: MRDHTWRM<--E1ENHCLE Phone: (402) 697-2627

] Current description of the analyses performed is inadequate. Include the
] preparatory method used with methods 8081 and 8270, and the preparatory
] and determinative methods used for the metals analyses.
======= Response: DONE: Where?
] Preparatory method 3540 has been added to 8081 and 8270 as requested.
] Metals analyses are in accordance with ILM04.0, and text has been modified
] to reflect that.

==
609939 GROENJES CEMRO-HX-C CHEM 4-1 4.1.1
-- Routing: MRDHTWRM<--E1ENHCLE Phone: (402) 697-2627

] The 2nd sentence contains a slight misnomer: m,p-xylene is not one
] compound. Due to the coelution of these 2 compounds (meta-xylene and
] para-xylene), laboratory 's commonly report them as a combination of both
] compounds. Suggest editing this sentence slightly for clarity.
======= Response: DONE: Where?
] Sentence has been modified to indicate that m- and p-xylene are two
] compounds, but that the analytical data are given as a single value
] representing a combination of the two compounds.

==
609940 GROENJES CEMRO-HX-C CHEM 4-3 4.4.1
-- Routing: MRDHTWRM<--E1ENHCLE Phone: (402) 697-2627

] The application of TCLP criteria as stated in the second sentence is not
] consistent with previous section's text, and overall is NOT advisable. All
] previous discussions of soil and sediment results have utilized the EPA
] Region III Soil Screening Levels. Suggest continuing this application, in
] lieu of the present approach.
======= Response: DONE: Where?
] Concur. Use of TCLP criteria has been dropped, and all references will be
] to EPA Region III SSLs.

Project: NAB9435 - ARL AREA 500

Review: Draft RI Rep

Univ ID # Last Name Ofc Symbol Discipline Page/Sheet # Rm/Detail

==

609941 GROENJES CEMRO-HX-C CHEM general general

-- Routing: MRDHTWRM<--E1ENHCLE Phone: (402) 697-2627

] The symbol for Thallium is Tl not Th. Edit accordingly.

======= Response: DONE: Where?

] Change made as requested.

==

609942 TATE CEMRO-HX-E CHEM. ENGINEER 6-1 1.)

-- Routing: MRDHTWRM<--E1ENHCLE Phone: (402) 697-2627

] A baseline risk assessment is normally included in the RI.

======= Response: DONE: Where?

] A baseline risk assessment was not part of the scope for the draft RI. A
] human health risk assessment has been included as part of the draft final
] RI.

==

609943 WALKER CEMRO-HX-H RISK ASSESSMENT 5-1 5.2.1

-- Routing: MRDHTWRM<--E1ENHCLE Phone: (402) 697-2627

] The comparison of the surface water detects to MCLs seems very
] inappropriate, unless this water is used as a drinking water source. A
] more appropriate screen would be to Ambient Water Quality Criteria (AWQC).
] The Federal AWQC for fresh water species are 45 mg/L (acute) and 21.9 mg/L
] (chronic). Note that both detects are below these levels.

======= Response: DONE: Where?

] Disagree. Use of AWQC for fresh water species would be appropriate for an
] ecological risk assessment, but that is not being performed for this RI. A
] potential human health risk, however, is associated with ingestion of
] surface water. For that reason use of the drinking water MCL has been
] adopted. This discussion is not intended to imply that any remedial
] efforts would have to meet MCL criteria.

==

609944 WALKER CEMRO-HX-H RISK ASSESSMENT 5-2 5.4

-- Routing: MRDHTWRM<--E1ENHCLE Phone: (402) 697-2627

] The conclusion that the source of both the TCE and RDX in groundwater is
] the NSWC property seems well founded. With that in mind, continued
] groundwater monitoring and the performance of a risk assessment should be
] the responsibility of the NSWC, not the USACE. Please reevaluate.

======= Response: DONE: Where?

] Agree with the statement that the source identification is well founded.
] However, one purpose of this RI is to provide conclusive evidence to the
] concerned parties (RAB, NSWC, etc.) that the ultimate source of the
] problem is on NSWC property. The fact remains, though, that discharge
] from the oil/water separator at Bldg 500 is indirectly contributing to the
] problem by discharging groundwater from beneath Bldg 500 through the
] effluent pipe. It is our understanding that, upon conclusion of this
] investigation, the Navy will be assuming responsibility for further
] action(s).

Univ ID # Last Name Ofc Symbol Discipline Page/Sheet # Rm/Detail

==
806762 CRAIG ALC ENV GENERAL
-- Routing: NABL6REV<--E1ENHCLE Phone: (410) 962-4450

] I question why Total Petroleum Hydrocarbons (TPH) was not included as a
] analyte of concern. The 1994 sampling effort by the Army Environmental
] Hygiene Agency detected TPH in all four wells, A-1 through A-4, inclusive,
] at levels ranging from 0.4 to 2.3 parts per million (ppm).
======= Response: DONE: Where?
] TPH-DRO was added to the scope of work subsequent to generation of the
] draft RI. The draft final RI contains TPH-DRO results for all monitoring
] wells, residential wells and surface water.

==
806763 CRAIG ALC ENV GENERAL
-- Routing: NABL6REV<--E1ENHCLE Phone: (410) 962-4450

] As I pointed out to your Mr. Christopher Evans some months ago,
] corrections were necessary to Figure 3-5 (erroneous contour data) and
] Figure 4-2 (erroneous concentration data). I have been provided with
] corrected figures, but these corrected figures need to be incorporated
] into the final RI Report.
======= Response: DONE: Where?
] Corrected figures have been incorporated into the draft final RI as
] requested.

==
806764 CRAIG ALC ENV GENERAL
-- Routing: NABL6REV<--E1ENHCLE Phone: (410) 962-4450

] Please ensure that TPH and thallium are included in the next round of
] on-site sampling. Detection limit for TPH should be 0.200 ppm or better.
] Detection limit for thallium should be 0.002 mg/L or better.
======= Response: DONE: Where?
] TPH-DRO and Tl were added to subsequent sampling events. A reporting
] limit of 0.0005 mg/l was achieved for Tl. The laboratory's reporting
] limit for TPH-DRO was 1 mg/l.

==
806765 DAVIS MDE ENV 3-3
-- Routing: NABL6REV<--E1ENHCLE Phone: (410) 962-4450

] Section 3.5.2 Bedrock Hydrogeology - Even though C-11 was installed in
] unfractured bedrock, this is not an indication that no fracture zones with
] higher hydraulic conductivity exist in the area. Please expand upon this
] in this section.
======= Response: DONE: Where?
] Section has been modified to reflect uncertainty about bedrock
] characteristics in areas not encountered during this investigation. Data
] from C-14 and C-15 have been added to the discussion, but conclusions
] about the bedrock, as evidenced by this investigation, have not changed
] from the draft RI.

Univ ID # Last Name Ofc Symbol Discipline Page/Sheet # Rm/Detail

==
806766 DAVIS MDE ENV 4-1
-- Routing: NABL6REV<--E1ENHCLE Phone: (410) 962-4450

] Section 4.2.1 Surface Water - The contaminant levels in surface water
] should be compared to the Toxic Substances Criteria for Ambient Surface
] Waters as referenced in the Code of Maryland Regulations 26.08.02.03.
======= Response: DONE: Where?
] Given that an ecological risk assessment is not part of the scope of work
] for this RI, the only values in COMAR 26.08.02.03 that are applicable are
] the drinking water criteria. The drinking water criteria are equivalent
] to the MCLs used in this RI. MCLs are viewed as being the most
] appropriate screening values for surface water, because of the potential
] ingestion hazard. For this reason, surface water, groundwater, and
] residential well water are compared to the same MCL.

==
806767 DAVIS MDE ENV 4-2
-- Routing: NABL6REV<--E1ENHCLE Phone: (410) 962-4450

] Section 4.3.1 Volatile Organic Compounds - 2nd paragraph, Is
] hydrogenolysis equivalent to reductive dehalogenation? Please clarify
] this section.
======= Response: DONE: Where?
] Hydrogenolysis is not equivalent to reductive dehalogenation. The text
] has been modified to reductive dehalogenation.

==
806768 DAVIS MDE ENV 4-3
-- Routing: NABL6REV<--E1ENHCLE Phone: (410) 962-4450

] Section 4.4.2 Groundwater and Surface Water - last paragraph, see comment
] #2 (COMAR 26.08.02.03).
======= Response: DONE: Where?
] See response to comment #13.

==
806769 DAVIS MDE ENV 5-1
-- Routing: NABL6REV<--E1ENHCLE Phone: (410) 962-4450

] Section 5.2.1 Surface Water - See comment #2 (COMAR 26.08.02.03).
======= Response: DONE: Where?
] See response to comment #13.

==
806770 DAVIS MDE ENV 5-2
-- Routing: NABL6REV<--E1ENHCLE Phone: (410) 962-4450

] Section 5.4 Significant Findings - See comment #2 (COMAR 26.08.02.03).
======= Response: DONE: Where?
] See response to comment #13.

Project: NAB9435 - ARL AREA 500

Review: Draft RI Rep

Univ ID #	Last Name	Ofc Symbol	Discipline	Page/Sheet # Rm/Detail
806774	DAVIS	MDE	ENV	APP F

-- Routing: NABL6REV<--E1ENHCLE Phone: (410) 962-4450

] For Appendix F:
]
] a. Chain of custody forms were not filled out correctly or completely in
] several instances. This could jepardize the usefulness of the data and
] should be better managed in the future.
]
] b. For job #8709, Chemron sample #56653
] 1) Client Sample ID: Cardboard container. The Quality Assurance Project
] Plan does not list a "cardboard container" as an appropriate or approved
] sample container. It is not appropriate to put samples collected during
] Comprehensive Environmental Response, Compensation and Liability Act
] (CERCLA)-related investigations into cardboard containers. Please clarify
] this discrepancy.
] 2) Sample Matrix: organic liquid. The text of the report does not
] discuss any instances of organic liquids being present in any of the
] monitoring wells. This sample matrix presumes that free product was
] present in at least one of the monitoring wells. Please clarify this
] discrepancy.
] 3) The units of measurement for this sample are mg/kg. Units of
] measure for liquid samples are generally milligrams per liter. Please
] clarify this discrepancy.

======= Response: DONE: Where?

] Comment (a) is noted. Comment (b): The sample was unfortunately mislabeled
] as a cardboard container. The sample was actually contained in a jar
] within the cardboard container. This sample was a sample of the dielectric
] fluid from Bldg 500. Analysis was not included as part of the original
] scope of work, but was added as a courtesy to the customer in the hopes
] that a distinctive fingerprint for this type of dielectric fluid could be
] found. This sample did not come from a monitoring well. The units given
] (mg/kg) are appropriate for petroleum based fluids. In sample preparation,
] difficulty in obtaining volumetric measurement (due to adhesion to
] surfaces) results in measurements being made by mass. Reporting units as
] mg/kg also avoids equating mg/l with ppm. This equivalence is only true
] for fluids with a density equal to that of water.

Project: NAB9435 - ARL AREA 500
Review: Draft Final

Univ ID # Last Name Ofc Symbol Discipline Page/Sheet # Rm/Detail

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824452 GEORG CENAB-EN-I INH
-- Routing: E1ENHIH<--E1ENHDKC<--E1ENHCLE Phone: (410)962-2714

] Document reviewed: Draft Final Report of Remedial Investigation at the
] Building 500 Area, ARL-Adelphi Laboratory Center, Adelphi, MD.
]
] A/E Response (DONE: Where?)
] By: HTRW Branch Generic AE (AE)
]
] Noted.
======= Temporary Response: DONE: Where?
] Noted.

824453 GEORG CENAB-EN-I INH 41 6.3.2
-- Routing: E1ENHIH<--E1ENHDKC<--E1ENHCLE Phone: (410)962-2714

] Second paragraph, third sentence, (0.25=0.66) should read (0.25+0.66).
]
] A/E Response (DONE: Where?)
] By: HTRW Branch Generic AE (AE)
]
] Text was modified as requested.
======= Temporary Response: DONE: Where?
] Text was modified as requested.

824454 GEORG CENAB-EN-I INH
-- Routing: E1ENHIH<--E1ENHDKC<--E1ENHCLE Phone: (410)962-2714

] The RI report, contaminant fate and transport, and baseline risk
] assessment were found to be complete and acceptable. No further comments
] at this time.
]
] A/E Response (DONE: Where?)
] By: HTRW Branch Generic AE (AE)
]
] Comment noted.
======= Temporary Response: DONE: Where?
] Comment noted.

Univ ID # Last Name Ofc Symbol Discipline Page/Sheet # Rm/Detail

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824455 GEORG CENAB-EN-I INH
-- Routing: E1ENHIH<--E1ENHDKC<--E1ENHCLE Phone: (410)962-2714

] The POC for the above comments is Craig Georg, at (410) 962-6738.
]
] A/E Response (DONE: Where?)
] By: HTRW Branch Generic AE (AE)
]
] Noted.
======= Temporary Response: DONE: Where?
] Noted.

824456 GEORG CENAB-EN-I INH
-- Routing: E1ENHIH<--E1ENHDKC<--E1ENHCLE Phone: (410)962-2714

] TM Annotation: WITHDRAWN - By E1ENHCLE (Chris Evans (TM))
]
] A/E Response (DONE: Where?)
] By: HTRW Branch Generic AE (AE)
]
] Noted.
======= Temporary Response: DONE: Where?
] Noted.

824462 CHANG CENAB-EN-H CHEMISTRY
-- Routing: E1ENHIH<--E1ENHDKC<--E1ENHCLE Phone: (410)962-2714

] Document reviewed: Draft Final Report of Remedial Investigation at the
] Building 500 Area, ARL-Adelphi Laboratory Center, Adelphi, MD.
]
] A/E Response (DONE: Where?)
] By: HTRW Branch Generic AE (AE)
]
] Noted.
======= Temporary Response: DONE: Where?
] Noted.

Univ ID # Last Name Ofc Symbol Discipline Page/Sheet # Rm/Detail

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824463 CHANG CENAB-EN-H CHEMISTRY General
-- Routing: E1ENHIH<--E1ENHDKC<--E1ENHCLE Phone: (410)962-2714

] The Chemical Quality Assurance Report (CQAR) from the USACE QA Laboratory
] for the Laboratory Analytical Data obtained in the Phase I is not included
] in Appendix F. The method detection limits of the analytical methods used
] in the Phase I are different from those of the analytical methods used in
] the Phase II. This difference of the detection limits in the two Phases
] manifests in the different sample results of the analytical data for the
] same sample location: for instance, TCE exceeded the groundwater above MCL
] of 5 ug/l in the monitoring well sample A-2 in the Phase II (see Section
] 4.3.2 on Page 21). But TCE was not detected in the A-2 sample in the Phase
] I (see Section 4.3.1 on Page 20). Recommend that a new appendix be created
] in this report to include the CQAR for the Phase I QA results and the
] statement of the difference in the analytical method detection limits for
] the two Phases to clarify the analytical difference in the Phase II and to
] support the scientific soundness of the chemical data and analytical
] results obtained in each Phase.
]
] A/E Response (DONE: Where?)
] By: HTRW Branch Generic AE (AE)
]
] The CQAR from the QA laboratory for Phase I has been included. The
] difference in detection limits is due to different contract laboratories
] performing the analyses. The different TCE values is due to the different
] sampling times(seasons).Data between labs is considered to agree < 5x
] difference when one result is < DL.
======= Temporary Response: DONE: Where?
] The CQAR from the QA laboratory for Phase I has been included. The
] difference in detection limits is due to different contract laboratories
] performing the analyses. The different TCE values is due to the different
] sampling times(seasons).Data between labs is considered to agree < 5x
] difference when one result is < DL.

Univ ID # Last Name Ofc Symbol Discipline Page/Sheet # Rm/Detail

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824464 CHANG CENAB-EN-H CHEMISTRY General
-- Routing: E1ENHIH<--E1ENHDKC<--E1ENHCLE Phone: (410)962-2714

] The chemical data, analytical results and conclusions of this Remedial
] Investigation Report are acceptable if the QA/QC results for the two
] Phases are clarified and presented.
]
] A/E Response (DONE: Where?)
] By: HTRW Branch Generic AE (AE)
]
] The CQAR has been added for Phase I and Round 2 will be added as an
] attachment when received.
======= Temporary Response: DONE: Where?
] The CQAR has been added for Phase I and Round 2 will be added as an
] attachment when received.

824465 CHANG CENAB-EN-H CHEMISTRY
-- Routing: E1ENHIH<--E1ENHDKC<--E1ENHCLE Phone: (410)962-2714

] The POC for the above comments is Scott H. Chang, Ph.D. at Ext.67-39.
]
] A/E Response (DONE: Where?)
] By: HTRW Branch Generic AE (AE)
]
] Noted.
======= Temporary Response: DONE: Where?
] Noted.

826133 COLOZZA CENAB-EN-G GGY 2
-- Routing: NABL6REV<--NABL2DW<--E1ENHCLE Phone: (410) 962-6642

] Section 1.3.1: First sentence, delete the word "the" in front of
] Wash.D.C..
]
] A/E Response (DONE: Where?)
] By: HTRW Branch Generic AE (AE)
]
] Text has been modified as requested.
======= Temporary Response: DONE: Where?
] Text has been modified as requested.

Univ ID # Last Name Ofc Symbol Discipline Page/Sheet # Rm/Detail

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826134 COLOZZA CENAB-EN-G GGY 3
-- Routing: NABL6REV<--NABL2DW<--E1ENHCLE Phone: (410) 962-6642

] Section 1.3.3.1: Second paragraph, second sentence, delete the word
] "from" in front of and is a potential source.....
]
] A/E Response (DONE: Where?)
] By: HTRW Branch Generic AE (AE)
]
] Text has been modified as requested.
======= Temporary Response: DONE: Where?
] Text has been modified as requested.

826135 COLOZZA CENAB-EN-G GGY 5
-- Routing: NABL6REV<--NABL2DW<--E1ENHCLE Phone: (410) 962-6642

] Section 2.1.1: Third paragraph, delete "total organic content" and use %
] organic matter. The test does not measure total organic content. Also, in
] this paragraph add the name of the geotech testing lab.
]
] A/E Response (DONE: Where?)
] By: HTRW Branch Generic AE (AE)
]
] Text has been modified as requested. Also, name of geotech lab has been
] added.
======= Temporary Response: DONE: Where?
] Text has been modified as requested. Also, name of geotech lab has been
] added.

826136 COLOZZA CENAB-EN-G GGY 6
-- Routing: NABL6REV<--NABL2DW<--E1ENHCLE Phone: (410) 962-6642

] Section 2.1.1: Fifth paragraph, last sentence, delete "in the field" and
] add the name of the subcontractor.
]
] A/E Response (DONE: Where?)
] By: HTRW Branch Generic AE (AE)
]
] Text has been deleted, and surveying subcontractor has been added as
] requested.
======= Temporary Response: DONE: Where?
] Text has been deleted, and surveying subcontractor has been added as
] requested.

Univ ID # Last Name Ofc Symbol Discipline Page/Sheet # Rm/Detail

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826137 COLOZZA CENAB-EN-G GGY 13
-- Routing: NABL6REV<--NABL2DW<--E1ENHCLE Phone: (410) 962-6642

] Section 3.1: The facility is identified as being 10 miles from Wash.D.C,
] but on page 2 in section 1.3.1 you say it is 5 miles from Waosh.D.C..
] Please check the distance.
]
] A/E Response (DONE: Where?)
] By: HTRW Branch Generic AE (AE)
]
] Appropriate text has been changed to reflect actual distance of 5 miles
] from Wash DC.
====== Temporary Response: DONE: Where?
] Appropriate text has been changed to reflect actual distance of 5 miles
] from Wash DC.

826138 COLOZZA CENAB-EN-G GGY 14
-- Routing: NABL6REV<--NABL2DW<--E1ENHCLE Phone: (410) 962-6642

] Section 3.4: third paragraph eighth sentence, delete "and rock" from end
] of sentence.
]
] A/E Response (DONE: Where?)
] By: HTRW Branch Generic AE (AE)
]
] Words "and rock" have not been deleted. Original phrasing was unclear.
] Sentence has been modified as follows, "...decomposed rock and
] unweathered, competent rock."
====== Temporary Response: DONE: Where?
] Words "and rock" have not been deleted. Original phrasing was unclear.
] Sentence has been modified as follows, "...decomposed rock and
] unweathered, competent rock."

826139 COLOZZA CENAB-EN-G GGY 21
-- Routing: NABL6REV<--NABL2DW<--E1ENHCLE Phone: (410) 962-6642

] Section 4.3.2: Second sentence, there is no mention of the grout seal
] problem in the referenced section. Please add an appropriate paragraph to
] section 2.12.2.
]
] A/E Response (DONE: Where?)
] By: HTRW Branch Generic AE (AE)
]
] Discussion was inadvertently left out of copy of Draft Final that went
] ouDt for review. Grout seal problem is addressed in Final RI.
====== Temporary Response: DONE: Where?
] Discussion was inadvertently left out of copy of Draft Final that went out
] for review. Grout seal problem is addressed in Final RI.

Univ ID # Last Name Ofc Symbol Discipline Page/Sheet # Rm/Detail

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826140 COLOZZA CENAB-EN-G GGY FIG. 2-1
-- Routing: NABL6REV<--NABL2DW<--E1ENHCLE Phone: (410) 962-6642

] FIGURE 2-1: Change title to WATER/SEDIMENT SAMPLE LOCATION MAP. The
] current title is not inclusive of all sampling activities.
]
] A/E Response (DONE: Where?)
] By: HTRW Branch Generic AE (AE)
]
] Title changed as requested.
======= Temporary Response: DONE: Where?
] Title changed as requested.

826141 COLOZZA CENAB-EN-G GGY FIGURES
-- Routing: NABL6REV<--NABL2DW<--E1ENHCLE Phone: (410) 962-6642

] FIGURES 3-4, 3-5 and 3-6: Add a contour symbol to the legend and the date
] of the data set used.
]
] A/E Response (DONE: Where?)
] By: HTRW Branch Generic AE (AE)
]
] Contour symbol has been added to the legend as requested. Data set date
] was provided on figures, however title block has been modified to make
] date more obvious.
======= Temporary Response: DONE: Where?
] Contour symbol has been added to the legend as requested. Data set date
] was provided on figures, however title block has been modified to make
] date more obvious.

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826142 COLOZZA CENAB-EN-G GGY APX. B
-- Routing: NABL6REV<--NABL2DW<--E1ENHCLE Phone: (410) 962-6642

] APPENDIX-B: The monitoring well records are misleading. The schematic
] diagram does not match the text. Grout is indicated where no grout was
] used and surface cement seal is indicated where a gravel pad was
] installed. Also, for hole C-13, please explain what Sika grovut is
] composed of.
]
] For the open hole bedrock wells, the word screen should be removed from
] the well record.
]
] A/E Response (DONE: Where?)
] By: HTRW Branch Generic AE (AE)
]
] Schematic diagrams have been corrected to represent actual well
] construction details. Sika is a tradename for a fast-setting cement.
] Screen has been removed from the open hole well records as requested.
======= Temporary Response: DONE: Where?
] Schematic diagrams have been corrected to represent actual well
] construction details. Sika is a tradename for a fast-setting cement.
] Screen has been removed from the open hole well records as requested.

827744 EVANS CENAB-EN-G GEO General
-- Routing: NABL6REV<--E1ENHCLE Phone: (410) 962-6642

] Major Comment: After reading this draft final report and considering the
] results of the Aug 97 sampling event, I believe that best approach is to
] incorporate the Aug 97 data into the Final RI Report. I realize that this
] is a change in project philosophy (we had planned to publish a separate
] letter report), but with the delays it seems prudent to have all of the RI
] data under one cover. The project team should meet after all comments are
] available to discuss this issue in more detail before a decision is made.
]
] A/E Response (DONE: Where?)
] By: HTRW Branch Generic AE (AE)
]
] Aug 97 data have been incorporated as requested.
======= Temporary Response: DONE: Where?
] Aug 97 data have been incorporated as requested.

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827745 EVANS CENAB-EN-G GEO iii
-- Routing: NABL6REV<--E1ENHCLE Phone: (410) 962-6642

] Please make the following corrections to the Table of Contents:
]
] a. The titles for sections 5.1 and 5.1.1 don't match the text.
]
] b. The titles for sections 6.2.1.4, 6.2.2.4, and 6.2.3.3 don't match the
] text.
]
] c. The title for section 7.1.2.1 doesn't match the text.
]
] d. For the List of Tables, Table 6-1 is not in provided in the table
] section, but instead is embedded in the report text. Shouldn't we follow
] the same convention for all tables?
]
] A/E Response (DONE: Where?)
] By: HTRW Branch Generic AE (AE)
]
] a), b), and c) Table of Contents has been changed to reflect headings
] and)discussions in text.
]
] d) Concur. Table 6-1 has been moved to table section.
====== Temporary Response: DONE: Where?
] a), b), and c) Table of Contents has been changed to reflect headings and
] discussions in text.
]
] d) Concur. Table 6-1 has been moved to table section.

827746 EVANS CENAB-EN-G GEO vi
-- Routing: NABL6REV<--E1ENHCLE Phone: (410) 962-6642

] For the Acronym list, the following inorganic abbreviations have not been
] provided:
]
] Ba - Barium Cd - Cadmium Ni - Nickel Tl - Thallium
]
] A/E Response (DONE: Where?)
] By: HTRW Branch Generic AE (AE)
]
] Acronyms have been added as requested.
====== Temporary Response: DONE: Where?
] Acronyms have been added as requested.

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827747 EVANS CENAB-EN-G GEO ES-1
-- Routing: NABL6REV<--E1ENHCLE Phone: (410) 962-6642

] For the Executive Summary:
]
] a. second paragraph, second sentence, change text in two places to seven
] wells for Phase I and not six as shown here.
]
] b. second paragraph, third sentence, add "off-site" before "residential
] wells".
]
] c. fifteenth paragraph, third bullet, add "off-site" before "residential
] wells".
]
] A/E Response (DONE: Where?)
] By: HTRW Branch Generic AE (AE)
]
] a), b) and c) All changes have been made as requested.
====== Temporary Response: DONE: Where?
] a), b) and c) All changes have been made as requested.

827748 EVANS CENAB-EN-G GEO 1
-- Routing: NABL6REV<--E1ENHCLE Phone: (410) 962-6642

] For section 1.1, second paragraph, second sentence, the dates shown for
] Phase I and Phase II do not agree with the dates provided in either the
] Executive Summary or Section 2. Please coordinate this information.
]
] A/E Response (DONE: Where?)
] By: HTRW Branch Generic AE (AE)
]
] Dates have been changed throughout document to be internally consistent.
====== Temporary Response: DONE: Where?
] Dates have been changed throughout document to be internally consistent.

827749 EVANS CENAB-EN-G GEO 2
-- Routing: NABL6REV<--E1ENHCLE Phone: (410) 962-6642

] For section 1.2.6, please add discussion to the text on the OWS sample.
]
] A/E Response (DONE: Where?)
] By: HTRW Branch Generic AE (AE)
]
] Section 1.2.6 has been expanded to include discussion of OWS sample.
====== Temporary Response: DONE: Where?
] Section 1.2.6 has been expanded to include discussion of OWS sample.

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827750 EVANS CENAB-EN-G GEO 2
-- Routing: NABL6REV<--E1ENHCLE Phone: (410) 962-6642

] For section 1.2.7, the title of this section is Sediment Sampling of the
] Site W Drainage Swale, however, sediment sampling was also conducted in
] the [redacted] Creeks. Please make appropriate corrections to the section text
] and title.
]
] A/E Response (DONE: Where?)
] By: HTRW Branch Generic AE (AE)
]
] Section title now includes [redacted] streams. Discussion has been expanded
] toSinclude sampling of [redacted] streams as requested.
======= Temporary Response: DONE: Where?
] Section title now includes [redacted] streams. Discussion has been expanded to
] include sampling of [redacted] streams as requested.

827751 EVANS CENAB-EN-G GEO 2
-- Routing: NABL6REV<--E1ENHCLE Phone: (410) 962-6642

] For section 1.2.8, the wordsmithing used to the describe uncertainty of
] off-site wells being downgradient of Building 500 is a bit confusing. Why
] don't we just assume that the residential wells are in fact downgradient
] of the contaminated plume?
]
] A/E Response (DONE: Where?)
] By: HTRW Branch Generic AE (AE)
]
] Phrasing has been strengthened to reflect that residential wells are
] [redacted] of Bldg 500.
======= Temporary Response: DONE: Where?
] Phrasing has been strengthened to reflect that residential wells are
] [redacted] of Bldg 500.

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827752 EVANS CENAB-EN-G GEO 3
-- Routing: NABL6REV<--E1ENHCLE Phone: (410) 962-6642

] For section 1.3.3.2, second paragraph, second sentence, please revise as
] follows: "... two former 890,000 gallon aboveground storage tanks
] (removed in 19XX) that contain ...".
]
] A/E Response (DONE: Where?)
] By: HTRW Branch Generic AE (AE)
]
] Text has been revised as requested. Date of removal, 1996, has been
] provided.
======= Temporary Response: DONE: Where?
] Text has been revised as requested. Date of removal, 1996, has been
] provided.

827753 EVANS CENAB-EN-G GEO 4
-- Routing: NABL6REV<--E1ENHCLE Phone: (410) 962-6642

] For section 1.3.3.3, first sentence, please provide the year that the Site
] W property was acquired by the Army.
]
] A/E Response (DONE: Where?)
] By: HTRW Branch Generic AE (AE)
]
] Year of acquisition, 1995, has been provided as requested.
======= Temporary Response: DONE: Where?
] Year of acquisition, 1995, has been provided as requested.

827754 EVANS CENAB-EN-G GEO 5
-- Routing: NABL6REV<--E1ENHCLE Phone: (410) 962-6642

] For section 2.0, second sentence, you have some comma problems to correct.
]
] A/E Response (DONE: Where?)
] By: HTRW Branch Generic AE (AE)
]
] Sentence structure has been corrected as requested.
======= Temporary Response: DONE: Where?
] Sentence structure has been corrected as requested.

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827755 EVANS CENAB-EN-G GEO 5
-- Routing: NABL6REV<--E1ENHCLE Phone: (410) 962-6642

] For section 2.1, the last sentence refers twice to the FSP which appears
] to be somewhat redundant.
]
] A/E Response (NOT DONE: Why Not?)
] By: HTRW Branch Generic AE (AE)
]
] No change has been made to text. References are to two separate FSPs
] (1996 and 1997).
====== Temporary Response: NOT DONE: Why Not?
] *No change has been made to text. References are to two separate FSPs*
] (1996 and 1997).

827756 EVANS CENAB-EN-G GEO 8
-- Routing: NABL6REV<--E1ENHCLE Phone: (410) 962-6642

] For section 2.4.2, second paragraph, ninth sentence has a typographical
] error.
]
] A/E Response (DONE: Where?)
] By: HTRW Branch Generic AE (AE)
]
] Typo has been corrected.
====== Temporary Response: DONE: Where?
] Typo has been corrected.

827757 EVANS CENAB-EN-G GEO 9
-- Routing: NABL6REV<--E1ENHCLE Phone: (410) 962-6642

] For section 2.6.2, please add discussion on the sampling of the OWS.
]
] A/E Response (DONE: Where?)
] By: HTRW Branch Generic AE (AE)
]
] Discussion has been expanded as requested to include sampling of the
====== Temporary Response: DONE: Where?
] Discussion has been expanded as requested to include sampling of the OWS.

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827758 EVANS CENAB-EN-G GEO 9
-- Routing: NABL6REV<--E1ENHCLE Phone: (410) 962-6642

] For section 2.7, the title should probably be changed to refer to sediment
] sampling beyond the Site W drainage swale.
]
] A/E Response (DONE: Where?)
] By: HTRW Branch Generic AE (AE)
]
] Section title has been modified to reflect sampling of sediments from
] Irbey streams.
====== Temporary Response: DONE: Where?
] Section title has been modified to reflect sampling of sediments from [redacted]
] streams.

827759 EVANS CENAB-EN-G GEO 12
-- Routing: NABL6REV<--E1ENHCLE Phone: (410) 962-6642

] For section 2.12.2, first paragraph, the last sentence has a typographical
] error.
]
] A/E Response (DONE: Where?)
] By: HTRW Branch Generic AE (AE)
]
] Typo has been corrected.
====== Temporary Response: DONE: Where?
] Typo has been corrected.

827760 EVANS CENAB-EN-G GEO 15
-- Routing: NABL6REV<--E1ENHCLE Phone: (410) 962-6642

] For section 3.5.1, second paragraph, any speculation why the borehole
] permeability test resulted in a K value one order of magnitude lower than
] the slug tests? Consider adding some text to clarify this issue.
]
] A/E Response (DONE: Where?)
] By: HTRW Branch Generic AE (AE)
]
] Discussion of test results has been expanded to address differences in
] test methods and lithologies.
====== Temporary Response: DONE: Where?
] Discussion of test results has been expanded to address differences in
] test methods and lithologies.

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827761 EVANS CENAB-EN-G GEO 23
-- Routing: NABL6REV<--E1ENHCLE Phone: (410) 962-6642

] For section 5.0, the text mentions 1,1,2,2-PCA as a compound of concern.
] However, section 4 does not present either data or discussion as to why it
] should be considered further. Perhaps you need to discuss this compound
] in more detail, especially in reference to TBC-RBC criteria in sections
] 4.3.1 and 4.3.2.
]
] A/E Response (DONE: Where?)
] By: HTRW Branch Generic AE (AE)
]
] Treatment of 1,1,2,2-PCA in Section 4 has been expanded to include
] comparison of concentrations to RBC/AWQC.
====== Temporary Response: DONE: Where?
] Treatment of 1,1,2,2-PCA in Section 4 has been expanded to include
] comparison of concentrations to RBC/AWQC.

827762 EVANS CENAB-EN-G GEO 23
-- Routing: NABL6REV<--E1ENHCLE Phone: (410) 962-6642

] For section 5.1, second paragraph, delete reference to sediment as
] 1,1,2,2-PCA was not detected in any sediment samples.
]
] A/E Response (DONE: Where?)
] By: HTRW Branch Generic AE (AE)
]
] Sediment has been deleted from the sentence.
====== Temporary Response: DONE: Where?
] Sediment has been deleted from the sentence.

827763 EVANS CENAB-EN-G GEO 23
-- Routing: NABL6REV<--E1ENHCLE Phone: (410) 962-6642

] For section 5.1, second paragraph, last sentence, your wordsmithing is
] confusing. I would prefer the statement: "There is no evidence of vinyl
] chloride at the Building 500 Area".
]
] A/E Response (DONE: Where?)
] By: HTRW Branch Generic AE (AE)
]
] "There is no evidence of vinyl chloride at the Building 500 Area." has
] been included.
====== Temporary Response: DONE: Where?
] "There is no evidence of vinyl chloride at the Building 500 Area." has
] been included.

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827764 EVANS CENAB-EN-G GEO 24
-- Routing: NABL6REV<--E1ENHCLE Phone: (410) 962-6642

] For section 5.3, Why is only Cd discussed here. The risk assessment also
] discusses Ba and Ni as COCs, therefore some discussion is warranted here
] as well.
]
] A/E Response (DONE: Where?)
] By: HTRW Branch Generic AE (AE)
]
] The screening levels were recalculated using current EPA guidance, and
] BaTand Ni are no longer considered COCs.
====== Temporary Response: DONE: Where?
] The screening levels were recalculated using current EPA guidance, and Ba
] and Ni are no longer considered COCs.

827765 EVANS CENAB-EN-G GEO 27
-- Routing: NABL6REV<--E1ENHCLE Phone: (410) 962-6642

] For section 6.1.2.1, the wordsmithing used to the describe uncertainty of
] off-site wells being downgradient of Building 500 is a bit confusing. Why
] don't we just assume that the residential wells are in fact downgradient
] of the contaminated plume?
]
] A/E Response (DONE: Where?)
] By: HTRW Branch Generic AE (AE)
]
] Concur and text changed.
====== Temporary Response: DONE: Where?
] Concur and text changed.

827766 EVANS CENAB-EN-G GEO 28
-- Routing: NABL6REV<--E1ENHCLE Phone: (410) 962-6642

] For section 6.1.2.4, second paragraph, the last sentence makes no sense.
]
] A/E Response (DONE: Where?)
] By: HTRW Branch Generic AE (AE)
]
] Concur and text changed.
====== Temporary Response: DONE: Where?
] Concur and text changed.

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827767 EVANS CENAB-EN-G GEO 43
-- Routing: NABL6REV<--E1ENHCLE Phone: (410) 962-6642

] In general, section 7.0 is a bit more detailed than is personally prefer.
] In many cases you repeat large portions of the text from earlier sections.
] Do we really need all that detail in the summary section?
]
] A/E Response (DONE: Where?)
] By: HTRW Branch Generic AE (AE)
]
] Section 7 has been rewritten to provide a more concise discussion of the
] findings of the RI.
======= Temporary Response: DONE: Where?
] Section 7 has been rewritten to provide a more concise discussion of the
] findings of the RI.

827768 EVANS CENAB-EN-G GEO 43
-- Routing: NABL6REV<--E1ENHCLE Phone: (410) 962-6642

] For section 7.1.1.2, please add a discussion of the OWS sampling results
] here.
]
] A/E Response (DONE: Where?)
] By: HTRW Branch Generic AE (AE)
]
] Section 7 has been substantially rewritten, and Section 7.1.1.2 no
] longeriexists. However, results of OWS sampling have been addressed.
======= Temporary Response: DONE: Where?
] Section 7 has been substantially rewritten, and Section 7.1.1.2 no longer
] exists. However, results of OWS sampling have been addressed.

827769 EVANS CENAB-EN-G GEO 44
-- Routing: NABL6REV<--E1ENHCLE Phone: (410) 962-6642

] For section 7.1.1.3.1, sixth paragraph, your wordsmithing on the
] subdrainage system is a bit tentative. Shouldn't we state that some
] groundwater is in fact being intercepted by the subdrainage system? After
] all, this water is coming from somewhere and it does have similar
] constituents to the contaminated groundwater plume.
]
] A/E Response (DONE: Where?)
] By: HTRW Branch Generic AE (AE)
]
] References to the subdrainage system have been modified to reflect that
] groundwater is being intercepted by the Bldg 500 subdrainage system.
======= Temporary Response: DONE: Where?
] References to the subdrainage system have been modified to reflect that
] groundwater is being intercepted by the Bldg 500 subdrainage system.

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827770 EVANS CENAB-EN-G GEO 46
-- Routing: NABL6REV<--E1ENHCLE Phone: (410) 962-6642

] For section 7.1.3, third paragraph, this discussion is very confusing. The
] risk assessment shows HQ>1 for maximum concentrations. This may need to be
] clarified a little better here.
]
] A/E Response (DONE: Where?)
] By: HTRW Branch Generic AE (AE)
]
] Concur and new paragraph written.
====== Temporary Response: DONE: Where?
] Concur and new paragraph written.

827771 EVANS CENAB-EN-G GEO 48
-- Routing: NABL6REV<--E1ENHCLE Phone: (410) 962-6642

] For section 7.2.1, subsection 3)b), I recommend that we also add surface
] water and sediment sampling of the streams west of Building 500 and near
] Floral Drive to our LTM program. Based on your discussions on
] hydrogeology and assuming we will sample the two proposed wells or other
] new and old Navy wells near these flowpaths, it makes sense to determine
] contaminant discharges as well.
]
] A/E Response (DONE: Where?)
] By: HTRW Branch Generic AE (AE)
]
] USACE investigations have been superseded by Navy investigations, and
] theSfocus of LTM will be restricted to sampling locations encompassed by
] theis RI.
====== Temporary Response: DONE: Where?
] USACE investigations have been superseded by Navy investigations, and the
] focus of LTM will be restricted to sampling locations encompassed by this
] RI.

827772 EVANS CENAB-EN-G GEO General
-- Routing: NABL6REV<--E1ENHCLE Phone: (410) 962-6642

] Questions on these comments can be directed to the author, Christopher
] Evans, at (410) 962-4431.
]
] A/E Response (DONE: Where?)
] By: HTRW Branch Generic AE (AE)
]
] Noted.
====== Temporary Response: DONE: Where?
] Noted.

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827773 TATE CENWO-HX-G 47 7.2
-- Routing: NABL6REV<--E1ENHCLE Phone: (410) 962-6642

] Page 47 Paragraph 7.2 Conclusions 7.2.1 Recommendations for Futures Work
] 2) Construction of a Weir in the Site W Swale: An EECA or an OUFS should
] be prepared with evaluation of the weir construction, the water quantity
] and quality to be treated and the cost of treatment at each of the
] suggested locations. Consideration should be given to sediment removal
] from the resulting impoundment.
]
] A/E Response (NOT DONE: Why Not?)
] By: HTRW Branch Generic AE (AE)
]
] Recommendation for construction of a weir has been removed from the RI
] report. Recommendation was more appropriate for a Feasibility Study, not
] a Remedial Investigation report. Navy investigations will be designed
] with the ultimate goal of providing remediation options.
======= Temporary Response: NOT DONE: Why Not?
] Recommendation for construction of a weir has been removed from the RI
] report. Recommendation was more appropriate for a Feasibility Study, not
] a Remedial Investigation report. Navy investigations will be designed
] with the ultimate goal of providing remediation options.

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827774 WALKER CENWO-HX-H RISK ASSESSMENT 28 6.1.3
-- Routing: NABL6REV<--E1ENHCLE Phone: (410) 962-6642

] This reviewer would question the use of AWQC for protection of human
] health for comparison to SW detections as the criteria are based either on
] ingestion of organisms and water, or ingestion of organisms only. As the
] discussion in Section 6.1.2.2 indicated that "...incidental ingestion of
] the surface water is not expected," this exposure route seems to be
] incomplete. Please clarify how this (or these) exposure route(s) could be
] significant at this site. (see Comment 4, also)
]
] A/E Response (DONE: Where?)
] By: HTRW Branch Generic AE (AE)
]
] Do not concur. The AWQC and SW comparisons will remain based on MDE
] providing a comment that Paint Branch Creek and its tributaries are
] protected waters for aquatic life, trout and recreational activties under
] MD regulations. MD regulators stated that AWQC would apply to these
] waters even though SW near Bldg. 500 are shallow creeks.
======= Temporary Response: DONE: Where?
] Do not concur. The AWQC and SW comparisons will remain based on MDE
] providing a comment that Paint Branch Creek and its tributaries are
] protected waters for aquatic life, trout and recreational activties under
] MD regulations. MD regulators stated that AWQC would apply to these
] waters even though SW near Bldg. 500 are shallow creeks.

827775 WALKER CENWO-HX-H RISK ASSESSMENT 40 6.3
-- Routing: NABL6REV<--E1ENHCLE Phone: (410) 962-6642

] The last sentence of this paragraph incorrectly equates insignificant
] exposure with an incomplete exposure pathway. The statement becomes true
] when "complete" is replaced with "insignificant." Please correct.
]
] A/E Response (DONE: Where?)
] By: HTRW Branch Generic AE (AE)
]
] Concur but Ni and Ba have been eliminated as COC because site-specific
] SSLs were calculated. Majority of paragraph has been rewritten.
======= Temporary Response: DONE: Where?
] Concur but Ni and Ba have been eliminated as COC because site-specific
] SSLs were calculated. Majority of paragraph has been rewritten.

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827776 WALKER CENWO-HX-H RISK ASSESSMENT 42 6.4
-- Routing: NABL6REV<--E1ENHCLE Phone: (410) 962-6642

] The CPSo for TCE was withdrawn by EPA in 1991 and has not been put forth
] for consideration since that time. At that time, the consensus was that
] TCE's human carcinogenicity was very questionable. Therefore, by utilizing
] the CPSo, in conjunction with the very conservative parameters for
] evaluation of risks, the uncertainty of "using the RBC TCE values" has
] been exacerbated, not minimized. This provides that the risks due to TCE
] have been overestimated, and would be expected to be less than those
] calculated.
]
] A/E Response (DONE: Where?)
] By: HTRW Branch Generic AE (AE)
]
] *Concur and change made in text.*
======= Temporary Response: DONE: Where?
] Concur and change made in text.

827777 WALKER CENWO-HX-H RISK ASSESSMENT 43 7.1.1.2
-- *Routing: NABL6REV<--E1ENHCLE Phone: (410) 962-6642*

] It was stated earlier that SW detects would be compared to AWQC. This
] section compares those values with MCLs. (The response to an earlier
] comment from this reviewer indicated that MCLs would be used but that the
] evaluation would not result in remediation.) Please clarify this
] inconsistency and add appropriate language to the Characterization of
] Uncertainty (Section 6.4).
]
] A/E Response (DONE: Where?)
] By: HTRW Branch Generic AE (AE)
]
] Based on requirements from MDE, surface water detections are being
] compared to relevant AWQC instead of MCLs as originally planned.
] Comparison of SW concentrations to MCLs has been removed from the RI
] report.
======= Temporary Response: DONE: Where?
] Based on requirements from MDE, surface water detections are being
] compared to relevant AWQC instead of MCLs as originally planned.
] Comparison of SW concentrations to MCLs has been removed from the RI
] report.

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827778 WALKER CENWO-HX-H RISK ASSESSMENT 43 7.1.1.2
-- Routing: NABL6REV<--E1ENHCLE Phone: (410) 962-6642

] TM Annotation: WITHDRAWN - By E1ENHCLE (Chris Evans (TM))
]
] A/E Response (DONE: Where?)
] By: HTRW Branch Generic AE (AE)
]
] Noted.
====== Temporary Response: DONE: Where?
] Noted.

827779 PERRY CENAB-EN-H ENV 12 2.12.2 Ph
-- Routing: NABL6REV<--E1ENHCLE Phone: (410) 962-6642

] 2.12.2 PHASE II: SECOND PARAGRAPH
]
] Indicate why the deviation occurred in the surface water sample. What was
] the purpose for the oil/water separator sample? You do not show reference
] to it anywhere else in the report.
]
] A/E Response (DONE: Where?)
] By: HTRW Branch Generic AE (AE)
]
] Discussion of the OWS sample has been expanded in Section 2.12.2, as
] wellsas other sections of the report. Expanded discussion includes
] rationa le for sampling at that location and reason for deviating from
] original sampling location.
====== Temporary Response: DONE: Where?
] Discussion of the OWS sample has been expanded in Section 2.12.2, as well
] as other sections of the report. Expanded discussion includes rationale
] for sampling at that location and reason for deviating from original
] sampling location.

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827780 PERRY CENAB-EN-H ENV 28 6.1.2.2 S
-- Routing: NABL6REV<--E1ENHCLE Phone: (410) 962-6642

] FIRST PARAGRAPH, SECOND SENTENCE
]
] Change "locations" to be "located"
]
] A/E Response (DONE: Where?)
] By: HTRW Branch Generic AE (AE)
]
] Do not concur. Either word is satisfactory for use in sentence and the
] original word maintained.
====== Temporary Response: DONE: Where?
] Do not concur. Either word is satisfactory for use in sentence and the
] original word maintained.

827781 PERRY CENAB-EN-H ENV
-- Routing: NABL6REV<--E1ENHCLE Phone: (410) 962-6642

] The Remedial Investigation and Design Section point of contact for this
] review is Mrs. Priscilla E. Perry at X5618.
]
] A/E Response (DONE: Where?)
] By: HTRW Branch Generic AE (AE)
]
] Noted.
====== Temporary Response: DONE: Where?
] Noted.

Univ ID # Last Name Ofc Symbol Discipline Page/Sheet # Rm/Detail

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827782 KOZAK Navy ENV General
-- Routing: NABL6REV<--E1ENHCLE Phone: (410) 962-6642

] Generally, we believe the risk assessment is grossly overconservative.
] Exposures to groundwater use the maximum detected onsite concentration to
] assess risks for all receptors.
]
] A/E Response (DONE: Where?)
] By: HTRW Branch Generic AE (AE)
]
] With nearby residents [redacted] with drinking water wells, migration
] off-site of site COC was a major concern. Even with the overconservative
] approach, cumulative cancer risks were in the EPA acceptable guidance
] range. If the most conservative approach does not result in cumulative
] cancer risks, all other approaches for the risk assessment will result in
] lesser cancer risks.
======= Temporary Response: DONE: Where?
] With nearby residents [redacted] with drinking water wells, migration
] off-site of site COC was a major concern. Even with the overconservative
] approach, cumulative cancer risks were in the EPA acceptable guidance
] range. If the most conservative approach does not result in cumulative
] cancer risks, all other approaches for the risk assessment will result in
] lesser cancer risks.

827783 KOZAK Navy ENV 6.1.2.2
-- Routing: NABL6REV<--E1ENHCLE Phone: (410) 962-6642

] The report states that the recreation/swimming pathway is unlikely, yet
] the pathway is still evaluated. This is somewhat inconsistent.
]
] A/E Response (DONE: Where?)
] By: HTRW Branch Generic AE (AE)
]
] Maryland regulators commented that Paint Branch Creek and its
] tributariesrare protected waters for aquatic life, trout, and recreational
] activities. Thus, AWQC were required by MD EPA for SW comparisons even
] though recreational use of the shallow creeks near Bldg. 500 is not
] expected.
======= Temporary Response: DONE: Where?
] Maryland regulators commented that Paint Branch Creek and its tributaries
] are protected waters for aquatic life, trout, and recreational activities.
] Thus, AWQC were required by MD EPA for SW comparisons even though
] recreational use of the shallow creeks near Bldg. 500 is not expected.

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827784 KOZAK Navy ENV 6.1.3
-- Routing: NABL6REV<--E1ENHCLE Phone: (410) 962-6642

] The report states that the TBCs for surface water data comparison are EPA
] AWQC and MDE AWQC. However, these are never presented in Table 4-2
] (Summary of Analytical Results for Groundwater and Surface Water Samples).
]
] A/E Response (DONE: Where?)
] By: HTRW Branch Generic AE (AE)
]
] Concur and table changed to reflect comment.
======= Temporary Response: DONE: Where?
] Concur and table changed to reflect comment.

827785 KOZAK Navy ENV 6.1.3.3
-- Routing: NABL6REV<--E1ENHCLE Phone: (410) 962-6642

] The report states that barium and nickel are naturally occurring. In the
] report, it's not clear where metals are compared to indigenous background
] concentrations.
]
] A/E Response (DONE: Where?)
] By: HTRW Branch Generic AE (AE)
]
] Ba and Ni were eliminated as COC because site-specific SSLs were used &
] calculated in the new version of the document.
======= Temporary Response: DONE: Where?
] Ba and Ni were eliminated as COC because site-specific SSLs were used &
] calculated in the new version of the document.

Univ ID # Last Name Ofc Symbol Discipline Page/Sheet # Rm/Detail

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827786 KOZAK Navy ENV 6.2.1.1
-- Routing: NABL6REV<--E1ENHCLE Phone: (410) 962-6642

] A surface water concentration of 140 ug/L TCE was reported at SW3 during
] round 2 sampling while a groundwater concentration of 79 ug/L TCE was
] detected at MW C-8 during round 2 sampling. This suggests that TCE is
] being "concentrated" in the surface water. Generally, the data don't
] appear "realistic" based on the groundwater flow according to Fig. 3-7
] (Groundwater Flow Map).
]
] It would seem more reasonable to assume that there are other sources,
] other than the groundwater located at C-8, discharging to the surface at
] the swale. Data collected from a recent Navy investigation, though the
] investigation is not complete and still on going, has suggested that the
] Navy may not be the sole source of TCE contamination.
]
] A/E Response (DONE: Where?)
] By: HTRW Branch Generic AE (AE)
]
] Figure 3-7 is (intentionally) a simplistic treatment of groundwater
] flow,uwhich presents a single flow path through C-8 into the Site W swale.
] In reality, groundwater is discharging to the swale from multiple flow
] paths, only one of which (passing through C-8) has been characterized. It
] is unreasonable to expect that C-8 represents the maximum concentration of
] contaminants discharging to the swale. Navy data are certainly consistent
] with other sources or with a plume that has fingers of varying levels of
] contamination.
====== Temporary Response: DONE: Where?
] Figure 3-7 is (intentionally) a simplistic treatment of groundwater flow,
] which presents a single flow path through C-8 into the Site W swale. In
] reality, groundwater is discharging to the swale from multiple flow paths,
] only one of which (passing through C-8) has been characterized. It is
] unreasonable to expect that C-8 represents the maximum concentration of
] contaminants discharging to the swale. Navy data are certainly consistent
] with other sources or with a plume that has fingers of varying levels of
] contamination.

Univ ID # Last Name Ofc Symbol Discipline Page/Sheet # Rm/Detail

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827787 KOZAK Navy ENV 6.2.1.2
-- Routing: NABL6REV<--E1ENHCLE Phone: (410) 962-6642

] The risks associated with exposure to TCE in groundwater are calculated
] using the maximum groundwater concentration of 160 ug/L. The calculation
] of risk assumes that groundwater is ingested onsite, even though the
] report states that it is unlikely. Constituents were never detected
] offsite in residential wells, yet onsite concentrations are used to assume
] risks.
]
] A/E Response (DONE: Where?)
] By: HTRW Branch Generic AE (AE)
]
] The highest detected concentrations were used because of the potential
] ofTTCE migration off-site. With the uncertainty of determining TCE's
] dilution through the GW pathway, the highest detection was used. Residents
] are located nearby and [redacted] of Bldg. 500 area.
====== Temporary Response: DONE: Where?
] The highest detected concentrations were used because of the potential of
] TCE migration off-site. With the uncertainty of determining TCE's
] dilution through the GW pathway, the highest detection was used. Residents
] are located nearby and [redacted] of Bldg. 500 area.

827788 KOZAK Navy ENV 6.2.3
-- Routing: NABL6REV<--E1ENHCLE Phone: (410) 962-6642

] Risk calculations for cadmium were performed using the total cadmium
] concentration instead of the dissolved concentration. This resulted in a
] hazard quotient greater than one. Using the dissolved concentration would
] provide a more representative HQ. The decision to use total cadmium
] instead of the dissolved concentration should be explained in the report.
]
] A/E Response (DONE: Where?)
] By: HTRW Branch Generic AE (AE)
]
] Concur. Text and calculations changed.
====== Temporary Response: DONE: Where?
] Concur. Text and calculations changed.

Univ ID # Last Name Ofc Symbol Discipline Page/Sheet # Rm/Detail

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827789 KOZAK Navy ENV 6.2.4.1
-- Routing: NABL6REV<--E1ENHCLE Phone: (410) 962-6642

] Risks were calculated for the exposure to bis(2-ethylhexl)phthalate. This
] is pointless since this compound was deemed irrelevant in that it is a
] common laboratory contaminant.
]
] A/E Response (DONE: Where?)
] By: HTRW Branch Generic AE (AE)
]
] Concur. BEHP eliminated as COC and explained in text.
====== Temporary Response: DONE: Where?
] Concur. BEHP eliminated as COC and explained in text.

827790 KOZAK Navy ENV General
-- Routing: NABL6REV<--E1ENHCLE Phone: (410) 962-6642

] If you have any questions regarding our comments, please call Ms. Kelli
] Kozak at (202) 685-3281.
]
] A/E Response (DONE: Where?)
] By: HTRW Branch Generic AE (AE)
]
] Noted.
====== Temporary Response: DONE: Where?
] Noted.

827791 ANGERMAN MDE ENV 1
-- Routing: NABL6REV<--E1ENHCLE Phone: (410) 962-6642

] Section 1.1 - Purpose, 2nd paragraph: Following the completion of the
] current RI field work activities and analytical data generation, the
] appropriate sections and appendices of the report should be updated.
]
] A/E Response (DONE: Where?)
] By: HTRW Branch Generic AE (AE)
]
] All pertinent sections of the report have been updated as requested.
====== Temporary Response: DONE: Where?
] All pertinent sections of the report have been updated as requested.

Univ ID # Last Name Ofc Symbol Discipline Page/Sheet # Rm/Detail

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827792 ANGERMAN MDE ENV 5
-- Routing: NABL6REV<--E1ENHCLE Phone: (410) 962-6642

] Section 2.0 - Field Investigation Program: See Comment #1.
]
] A/E Response (DONE: Where?)
] By: HTRW Branch Generic AE (AE)
]
] Section has been updated as requested.
====== Temporary Response: DONE: Where?
] Section has been updated as requested.

827793 ANGERMAN MDE ENV 11
-- Routing: NABL6REV<--E1ENHCLE Phone: (410) 962-6642

] Section 2.12 - Deviations from the Work Plan: The Maryland Department of
] the Environment's (MDE) Remedial Project Manager (RPM) should be contacted
] prior to conducting operations which differ from the work plan. This will
] assist the RPM in better understanding the circumstances for the deviation
] and appropriate alternatives.
]
] A/E Response (DONE: Where?)
] By: HTRW Branch Generic AE (AE)
]
] Noted.
====== Temporary Response: DONE: Where?
] Noted.

827794 ANGERMAN MDE ENV 11
-- Routing: NABL6REV<--E1ENHCLE Phone: (410) 962-6642

] Section 2.9 - Investigation Derived Waste (IDW) Management:
] The MDE considers materials identified as a waste, including IDW, to be
] subject to appropriate treatment and disposal requirements. Comments
] previously provided by the MDE on the draft version of this document,
] dated November 4, 1996, includes an evaluation protocol for determining if
] investigatory derived media (IDM) must be managed as a solid waste. The
] Army should consider revising this section to avoid prematurely
] identifying IDM as solid waste.
]
] A/E Response (DONE: Where?)
] By: HTRW Branch Generic AE (AE)
]
] All references to IDW have been replaced with IDM. Discussion no longer
] characterizes investigation derived media as "waste."
====== Temporary Response: DONE: Where?
] All references to IDW have been replaced with IDM. Discussion no longer
] characterizes investigation derived media as "waste."

Univ ID # Last Name Ofc Symbol Discipline Page/Sheet # Rm/Detail

827795 ANGERMAN MDE ENV 17
-- Routing: NABL6REV<--E1ENHCLE Phone: (410) 962-6642

] Section 3.5.4 - Hydraulic Gradient and Seepage Velocity, 2nd paragraph:
] This section states that the head differences in the overburden/bedrock
] well pairs indicate a strong downward gradient. However, the lack of
] appreciable amounts of groundwater in the bedrock aquifer appears to
] contradict this hypothesis. Additional evidence should be provided which
] further substantiates this conclusion.
]
] A/E Response (DONE: Where?)
] By: HTRW Branch Generic AE (AE)
]
] Discussion has been expanded to indicate that groundwater transport in
] bedrock is highly dependent on quantity and interconnectedness of
] fractures. In the absence of a good network of fractures (as is
] apparently the case at Bldg 500) the amount of groundwater in bedrock is
] likely to be negligible.
======= Temporary Response: DONE: Where?
] Discussion has been expanded to indicate that groundwater transport in
] bedrock is highly dependent on quantity and interconnectedness of
] fractures. In the absence of a good network of fractures (as is
] apparently the case at Bldg 500) the amount of groundwater in bedrock is
] likely to be negligible.

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827796 ANGERMAN MDE ENV 21
-- Routing: NABL6REV<--E1ENHCLE Phone: (410) 962-6642

] Section 4.3.2 - Volatile Organic Compounds, Phase II: This section states
] that the TCE detected in well C-14 is the result of a faulty seal.
] Additional measures should be considered to verify this. In addition,
] please note that the potentiometric head values within the bedrock wells
] may be affected by shallow groundwater leaking into the wells.
]
] In the event that the Army determines that a faulty seal is present in
] well C-14, measures should be taken to correct this problem.
]
] A/E Response (DONE: Where?)
] By: HTRW Branch Generic AE (AE)
]
] pH values (12.9) for C-14 obtained during the August sampling round are
] strongly suggetive of grout contamination. Based on this evidence, the
] bedrock well was rehabilitated (after consultation with MDE) by placing 2
] inch PVC inside the well and sealing off the faulty grout seal with
] packers and an additional grout seal.
]
] Observation that heads within the bedrock well may be affected by shallow
] groundwater is noted. However, communication between shallow and bedrock
] aquifers would tend to minimize observed head differences, not exacerbate
] them. Consequently, conclusions about downward gradients are still valid.
====== Temporary Response: DONE: Where?
] pH values (12.9) for C-14 obtained during the August sampling round are
] strongly suggetive of grout contamination. Based on this evidence, the
] bedrock well was rehabilitated (after consultation with MDE) by placing 2
] inch PVC inside the well and sealing off the faulty grout seal with
] packers and an additional grout seal.
]
] Observation that heads within the bedrock well may be affected by shallow
] groundwater is noted. However, communication between shallow and bedrock
] aquifers would tend to minimize observed head differences, not exacerbate
] them. Consequently, conclusions about downward gradients are still valid.

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827797 ANGERMAN MDE ENV 19
-- Routing: NABL6REV<--E1ENHCLE Phone: (410) 962-6642

] Section 4.2.3 - Surface Water, Phase II, 3rd paragraph: Please provide a
] more comprehensive evaluation of the explosives detected in surface water.
] For example, several health advisories (HA) are available for these
] compounds, such as the one- and ten-day HA for the child and the lifetime
] HA for the adult. Additionally, since an appropriate screening value has
] not been identified, the US Environmental Protection Agency (USEPA) has
] derived reference doses (RfD) for several of these chemicals, and
] therefore, noncarcinogenic risk can be quantitatively estimated.
]
] A/E Response (DONE: Where?)
] By: HTRW Branch Generic AE (AE)
]
] Concur. EPA Region III RBC's for tap water used as the reference
] guidancre to evaluate the explosives.
======= Temporary Response: DONE: Where?
] Concur. EPA Region III RBC's for tap water used as the reference guidance
] to evaluate the explosives.

827798 ANGERMAN MDE ENV 22
-- Routing: NABL6REV<--E1ENHCLE Phone: (410) 962-6642

] Section 4.3.7 - Explosives, Phase I and 4.3.8 - Explosives, Phase II:
] Please provide a more comprehensive evaluation of the explosives detected
] in groundwater - see comment #7 for additional information.
]
] A/E Response (DONE: Where?)
] By: HTRW Branch Generic AE (AE)
]
] Concur. EPA Region III RBC's were used as reference guidance for the
] explosives.
======= Temporary Response: DONE: Where?
] Concur. EPA Region III RBC's were used as reference guidance for the
] explosives.

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827799 ANGERMAN MDE ENV 26
-- Routing: NABL6REV<--E1ENHCLE Phone: (410) 962-6642

] Section 6.1.1 - Contaminants not Considered as COC: Eliminating lead in
] groundwater as a contaminant of concern (COC) based on lead detections in
] the residential well is a management decision, rather than a risk
] assessment decision, and should be clearly stated as such. Please clarify
] this issue.
]
] A/E Response (DONE: Where?)
] By: HTRW Branch Generic AE (AE)
]
] Concur. Text revised to also state that it was a management decision
] nototo carry the Pb forward in the risk assessment.
======= Temporary Response: DONE: Where?
] Concur. Text revised to also state that it was a management decision not
] to carry the Pb forward in the risk assessment.

827800 ANGERMAN MDE ENV 27
-- Routing: NABL6REV<--E1ENHCLE Phone: (410) 962-6642

] Section 6.1.2.2 - Surface Water: Paint Branch Creek carries a Use II
] designation in the Code of Maryland Regulation 26.08.02 (COMAR), and is
] protected for agricultural and industrial use, aquatic life, water contact
] recreation and fishing, and as a natural trout water. The text states that
] Paint Branch Creek and the nearby unnamed creeks are shallow and narrow.
] Please include a more detailed description of the water bodies, the use
] designation for these water bodies, and all appropriate ambient surface
] water quality standards and criteria for the protection of aquatic life
] and human health which must be met in these water bodies.
]
] A/E Response (DONE: Where?)
] By: HTRW Branch Generic AE (AE)
]
] Concur. Text revised to include the additional information provided in
] the comment. Because of the additional information SW will be compared to
] AWQCs even though human recreational use of the unnamed creeks near Bldg.
] 500 is not expected.
======= Temporary Response: DONE: Where?
] Concur. Text revised to include the additional information provided in
] the comment. Because of the additional information SW will be compared to
] AWQCs even though human recreational use of the unnamed creeks near Bldg.
] 500 is not expected.

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827801 ANGERMAN MDE ENV 28
-- Routing: NABL6REV<--E1ENHCLE Phone: (410) 962-6642

] Section 6.1.2.3 - Direct Contact with Soil: This section references Soil
] Screening Levels (SSL) which are included in Table 4-1. However, these
] SSLs are from the draft 1994 USEPA Guidance Document (EPA/540/R-94/101).
] This document has been superseded by the final version, Soil Screening
] Guidance: Technical Background Document (EPA/540/R-95/128). The most
] recent values have not been included in the most recent USEPA Region III
] Risk-Based Concentration (RBC) Table dated 3/14/97. One major difference
] between the SSLs from the draft document (and the RBC Table) and the final
] document is that the draft values from 1994 are based on a Dilution
] Attenuations Factor (DAF) of 10, whereas the final document derives SSLs
] based on a DAF of 10 and a DAF of 1. Therefore, if SSLs are being used to
] determine whether or not soil is a medium of concern, the appropriate DAF
] must be identified and the reasoning provided. Please correct Table 4-1
] and all relevant text.
]
] A/E Response (DONE: Where?)
] By: HTRW Branch Generic AE (AE)
]
] Concur. Site specific SSLs were calculated for the site using the EPA
] Soil Screening Guidance document (1995) and a DAF of 1 was used. The new
] information was included in text and Table 4-1 revised.
====== Temporary Response: DONE: Where?
] Concur. Site specific SSLs were calculated for the site using the EPA
] Soil Screening Guidance document (1995) and a DAF of 1 was used. The new
] information was included in text and Table 4-1 revised.

827802 ANGERMAN MDE ENV 28
-- Routing: NABL6REV<--E1ENHCLE Phone: (410) 962-6642

] Section 6.1.3 - Concentration Comparison with ARARs and TBC Criteria:
] Maryland ambient water quality standards shall be considered as ARARs,
] rather than TBC criteria. Please correct the text.
]
] A/E Response (DONE: Where?)
] By: HTRW Branch Generic AE (AE)
]
] Concur. Text revised.
====== Temporary Response: DONE: Where?
] Concur. Text revised.

Univ ID # Last Name Ofc Symbol Discipline Page/Sheet # Rm/Detail

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827803 ANGERMAN MDE ENV 29
-- Routing: NABL6REV<--E1ENHCLE Phone: (410) 962-6642

] Section 6.1.3.2 - Surface Water Quality TBC Criteria: Please revise this
] section to include the information requested in Comment #10.
]
] A/E Response (DONE: Where?)
] By: HTRW Branch Generic AE (AE)
]
] Concur. The text was revised.
======= Temporary Response: DONE: Where?
] Concur. The text was revised.

827804 ANGERMAN MDE ENV 29
-- Routing: NABL6REV<--E1ENHCLE Phone: (410) 962-6642

] Section 6.1.3.3 - Soil TBC Criteria: Please revise this section to
] include the appropriate SSLs and other information requested in Comment
] #11.
]
] A/E Response (DONE: Where?)
] By: HTRW Branch Generic AE (AE)
]
] Concur. Text was revised with the comment influencing the revision.
======= Temporary Response: DONE: Where?
] Concur. Text was revised with the comment influencing the revision.

827805 ANGERMAN MDE ENV 31
-- Routing: NABL6REV<--E1ENHCLE Phone: (410) 962-6642

] Section 6.2.1.2 - TCE Carcinogenic Risk in Groundwater, Inhalation Pathway
] for Trichloroethene/Groundwater:
]
] a) Please explain the inhalation rate of 0.6 m^3/hour (14 m^3/day). The
] USEPA recommended average inhalation rate is 0.83 m^3/hour (20 m^3/day)
] for adults (USEPA, Risk Assessment Guidance for Superfund,
] EPA/540/1-89/002).
]
] b) Please provide a reference for the volatilization factor.
]
] A/E Response (DONE: Where?)
] By: HTRW Branch Generic AE (AE)
]
] Concur. References for values shown in text.
======= Temporary Response: DONE: Where?
] Concur. References for values shown in text.

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827806 ANGERMAN MDE ENV 32
-- Routing: NABL6REV<--E1ENHCLE Phone: (410) 962-6642

] Section 6.2.1.2 - TCE Carcinogenic Risk in Groundwater, Dermal Contact
] Pathway for Trichloroethene/Groundwater:
]
] a) The correct unit for the conversion factor is 1 liter/1000 cm^3. Please
] correct this.
]
] b) Please provide a reference for the dermal permeability constant.
]
] c) The toxicity value used to estimate risk must be "matched" with the
] intake. For example, the intake for trichloroethene (TCE) is expressed as
] an absorbed dose, which means that the intake calculation incorporates the
] appropriate dermal permeability factors to adjust the exposure from an
] administered dose to an absorbed dose. The toxicity value, in this case,
] the cancer potency factor, must be consistent with the intake. Further
] discussion can be found in Appendix A of USEPA's Risk Assessment Guidance
] for Superfund. For TCE, the oral cancer potency factor is based on
] absorbed dose, and no adjustment is necessary. This is the reason the oral
] cancer potency factor is the most appropriate toxicity value, rather than
] it is the "more conservative value." Please revise the text to include
] this information.
]
] A/E Response (DONE: Where?)
] By: HTRW Branch Generic AE (AE)
]
] Concur. Conversion factor changed from 1 hour to 1 liter. Reference
] foroPC value stated in text as a revision. Text revised to state why CPS
] ooral was chosen over CPS inhalation.
====== Temporary Response: DONE: Where?
] Concur. Conversion factor changed from 1 hour to 1 liter. Reference for
] PC value stated in text as a revision. Text revised to state why CPS oral
] was chosen over CPS inhalation.

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827807 ANGERMAN MDE ENV 33
-- Routing: NABL6REV<--E1ENHCLE Phone: (410) 962-6642

] Section 6.2.1.3 - TCE Carcinogenic Risk in Surface Water, Dermal Contact
] Pathway for Trichloroethene/Surface Water:
]
] a) Please correct the unit for the conversion factor to 1 liter/1000 cm^3.
]
] b) Please provide a reference for the exposure time of 0.3 hours/day.
]
] c) Please revise the text which describes the use of oral cancer potency
] factor, as discussed in Comment #16 c).
]
] A/E Response (DONE: Where?)
] By: HTRW Branch Generic AE (AE)
]
] Concur. One hour changed to one liter and text revised to show why CPS
] oral was more appropriate than CPS inhalation.
]
] The reference for the 0.3 value can not be found. It seems an
] appropriate value when EPA list 2.6 hrs/day for swimming and 0.2 hrs/day
] for showering. With a potential scenario of walking through the SW, the
] value of 0.3 hrs/day was considered a good conservative upper bound value.
======= Temporary Response: DONE: Where?
] Concur. One hour changed to one liter and text revised to show why CPS
] oral was more appropriate than CPS inhalation.
]
] The reference for the 0.3 value can not be found. It seems an
] appropriate value when EPA list 2.6 hrs/day for swimming and 0.2 hrs/day
] for showering. With a potential scenario of walking through the SW, the
] value of 0.3 hrs/day was considered a good conservative upper bound value.

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827808 ANGERMAN MDE ENV 33
-- Routing: NABL6REV<--E1ENHCLE Phone: (410) 962-6642

] Section 6.2.1.4 - TCE Non-Carcinogenic Hazard: The non-carcinogenic risk
] has not been estimated for all populations considered for carcinogenic
] risk. Therefore, please revise this section to include the following:
]
] a) Please calculate the Hazard Quotient (HQ) for groundwater ingestion for
] the off-site child resident.
]
] b) Please calculate the HQ for dermal contact with groundwater for the
] off-site adult and child resident.
]
] c) Please calculate the HQ for dermal contact with surface water for the
] off-site adult residents, trespassers, Building 500 workers, and off-site
] child residents.
]
] A/E Response (DONE: Where?)
] By: HTRW Branch Generic AE (AE)
]
] Concur. The HQ for all potential populations and pathways were
] considere d and included in the revised text.
====== Temporary Response: DONE: Where?
] Concur. The HQ for all potential populations and pathways were considered
] and included in the revised text.

827809 ANGERMAN MDE ENV 34
-- Routing: NABL6REV<--E1ENHCLE Phone: (410) 962-6642

] Section 6.2.2.1 - 1,1,2,2-PCA Contamination at Site: Please include the
] off-site child resident in all exposure scenarios for both carcinogenic
] and non-carcinogenic risk.
]
] A/E Response (DONE: Where?)
] By: HTRW Branch Generic AE (AE)
]
] Concur. Text revised and new calculations performed as suggested.
====== Temporary Response: DONE: Where?
] Concur. Text revised and new calculations performed as suggested.

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827810 ANGERMAN MDE ENV 35
-- Routing: NABL6REV<--E1ENHCLE Phone: (410) 962-6642

] Section 6.2.2.2 - 1,1,2,2-PCA Carcinogenic Risk in Groundwater, Inhalation
] Pathway for 1,1,2,2-PCA/Groundwater: Please provide a reference for the
] volatilization factor for 1,1,2,2-PCA. It appears that the value used for
] TCE, 0.51 L/m^3, was also used for 1,1,2,2-PCA.
]
] A/E Response (DONE: Where?)
] By: HTRW Branch Generic AE (AE)
]
] Not Concur. The PCA volatilization factor is the same because it is a
] default "volatilization" constant upper bound value as provided in RAGS
] Part B.
====== Temporary Response: DONE: Where?
] Not Concur. The PCA volatilization factor is the same because it is a
] default "volatilization" constant upper bound value as provided in RAGS
] Part B.

827811 ANGERMAN MDE ENV 35
-- Routing: NABL6REV<--E1ENHCLE Phone: (410) 962-6642

] Section 6.2.2.2 - 1,1,2,2-PCA Carcinogenic Risk in Groundwater, Dermal
] Contact Pathway for 1,1,2,2-PCA/Groundwater: Please provide a reference
] for the dermal permeability constant for 1,1,2,2-PCA. It appears the value
] used for TCE, 0.016 cm/hr, was also used for 1,1,2,2-PCA.
]
] A/E Response (DONE: Where?)
] By: HTRW Branch Generic AE (AE)
]
] Concur. Text revised to show reference for the value. It was different
] from TCE so recalculations performed and text revised.
====== Temporary Response: DONE: Where?
] Concur. Text revised to show reference for the value. It was different
] from TCE so recalculations performed and text revised.

827812 ANGERMAN MDE ENV 36
-- Routing: NABL6REV<--E1ENHCLE Phone: (410) 962-6642

] Section 6.2.2.3 - 1,1,2,2-PCA Carcinogenic Risk in Surface Water: Please
] provide a reference for the dermal permeability constant.
]
] A/E Response (DONE: Where?)
] By: HTRW Branch Generic AE (AE)
]
] Concur. Text revised to show reference.
====== Temporary Response: DONE: Where?
] Concur. Text revised to show reference.

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827813 ANGERMAN MDE ENV 37
-- Routing: NABL6REV<--E1ENHCLE Phone: (410) 962-6642

] Section 6.2.3.3 - CD Non-Carcinogenic Hazard: Please calculate the HQ for
] groundwater ingestion for the off-site child resident.
]
] A/E Response (DONE: Where?)
] By: HTRW Branch Generic AE (AE)
]
] Concur. Text revised to show child HQ values.
====== Temporary Response: DONE: Where?
] Concur. Text revised to show child HQ values.

827814 ANGERMAN MDE ENV 38
-- Routing: NABL6REV<--E1ENHCLE Phone: (410) 962-6642

] Section 6.2.4 - Bis(2-ethylhexyl)phthalate (BEHP): The first sentence
] states that BEHP is eliminated as a COC based on probable laboratory
] contamination. The second sentence contradicts this by saying that BEHP
] was detected in a sample and is retained as a COC. Please clarify this.
]
] A/E Response (DONE: Where?)
] By: HTRW Branch Generic AE (AE)
]
] Concur. Text revised with elimination of BEHP and text strengthened to
] explain why.
====== Temporary Response: DONE: Where?
] Concur. Text revised with elimination of BEHP and text strengthened to
] explain why.

827815 ANGERMAN MDE ENV 38
-- Routing: NABL6REV<--E1ENHCLE Phone: (410) 962-6642

] Section 6.2.4.1 - BEHP Carcinogenic Risk in GW: Please calculate a cancer
] risk for groundwater ingestion for the off-site child resident.
]
] A/E Response (DONE: Where?)
] By: HTRW Branch Generic AE (AE)
]
] Not applicable. BEHP eliminated from consideration as COC.
====== Temporary Response: DONE: Where?
] Not applicable. BEHP eliminated from consideration as COC.

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827816 ANGERMAN MDE ENV 39
-- Routing: NABL6REV<--E1ENHCLE Phone: (410) 962-6642

] *Section 6.2.5 - Overall Carcinogenic Risk, BEHP Assessment:*
] USEPA's Integrated Risk Information System (IRIS) provides a reference
] dose (RfD) of 2E-02 mg/kg-day for BEHP to estimate non-carcinogenic risks.
] Please calculate HQs for all appropriate exposure pathways for the
] off-site adult and child residents.
]
] A/E Response (DONE: Where?)
] By: HTRW Branch Generic AE (AE)
]
] Not applicable. BEHP eliminated as a potential COC.
====== Temporary Response: DONE: Where?
] Not applicable. BEHP eliminated as a potential COC.

827817 ANGERMAN MDE ENV T 4-2
-- Routing: NABL6REV<--E1ENHCLE Phone: (410) 962-6642

] Table Section, Table 4-2: Please revise Table 4-2 to include the
] information presented in Comment #10.
]
] A/E Response (DONE: Where?)
] By: HTRW Branch Generic AE (AE)
]
] Table 4-2 has been revised to include MD AWQC.
====== Temporary Response: DONE: Where?
] Table 4-2 has been revised to include MD AWQC.

827818 ANGERMAN MDE ENV Tables
-- Routing: NABL6REV<--E1ENHCLE Phone: (410) 962-6642

] Table Section: It may be helpful to include all risk estimates in tabular
] form. This is an easy way to evaluate both carcinogenic and
] non-carcinogenic risk by chemical, individual pathway, and as a cumulative
] summation.
]
] A/E Response (DONE: Where?)
] By: HTRW Branch Generic AE (AE)
]
] Concur. New cumulative table provided in text.
====== Temporary Response: DONE: Where?
] Concur. New cumulative table provided in text.

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827819 ANGERMAN MDE ENV 43
-- Routing: NABL6REV<--E1ENHCLE Phone: (410) 962-6642

] Section 7.1.1.3.1 - Groundwater Hydrology: This section concludes that
] the coastal plain deposits and bedrock Wissahickon Formation behave as a
] single interconnected water-bearing unit. Volatile organic compounds
] (VOCs), Semi-VOCs, metals and explosives contamination were detected in
] the shallow groundwater of the coastal plain deposits, but not in the
] deeper bedrock unit. Please consider including a statement which evaluates
] the potential for contamination of the deeper bedrock water bearing unit
] and the residential bedrock wells located (b) (9) [redacted] from the subject
] site based on the findings of this RI.
]
] A/E Response (DONE: Where?)
] By: HTRW Branch Generic AE (AE)
]
] Section 7 has been extensively rewritten, and subject section
] (7.1.1.3.1) no longer exists. However, discussion about groundwater
] hydrol.ogy has been expanded to treat potential for contamination of
] bedrock. Specifically, text has been added to indicate that apparent
] absence of interconnected fractures makes migration of contamination into
] deeper bedrock very unlikely.
======= Temporary Response: DONE: Where?
] Section 7 has been extensively rewritten, and subject section (7.1.1.3.1)
] no longer exists. However, discussion about groundwater hydrology has
] been expanded to treat potential for contamination of bedrock.
] Specifically, text has been added to indicate that apparent absence of
] interconnected fractures makes migration of contamination into deeper
] bedrock very unlikely.

827820 ANGERMAN MDE ENV General
-- Routing: NABL6REV<--E1ENHCLE Phone: (410) 962-6642

] Questions on these comments can be directed to Mike Angermann, Remedial
] Project Manager, MDE Federal/Superfund Division at (410) 631-3440.
]
] A/E Response (DONE: Where?)
] By: HTRW Branch Generic AE (AE)
]
] Noted.
======= Temporary Response: DONE: Where?
] Noted.

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827821 CRAIG ALC ENV General
-- Routing: NABL6REV<--E1ENHCLE Phone: (410) 962-6642

] There are numerous inconsistencies in the dates cited for the two phases
] of the RI. Please edit the following sections to ensure consistency:
]
] a. Page ES-1 indicates that Phase I occurred "during May-July 1996" and
] Phase II occurred "during April and May 1997".
]
] b. Page 1 indicates that "Phase I was carried out in May and June 1996,
] and Phase II was carried out in May and June 1997".
]
] c. Page 5 reads "Phase I in May, June, and July, 1996, and Phase II in
] April and May, 1997".
]
] A/E Response (DONE: Where?)
] By: HTRW Branch Generic AE (AE)
]
] a), b) and c) Dates have been changed throughout report to be internally
] consistent.
====== Temporary Response: DONE: Where?
] a), b) and c) Dates have been changed throughout report to be internally
] consistent.

827822 CRAIG ALC ENV General
-- Routing: NABL6REV<--E1ENHCLE Phone: (410) 962-6642

] Section 6.0, Baseline Risk Assessment: I have noted that human exposure
] to sediment was omitted from the risk assessment. I believe that a better
] explanation of this omission would be appropriate.
]
] A/E Response (DONE: Where?)
] By: HTRW Branch Generic AE (AE)
]
] Concur. Text revised with the inclusion of sediment discussions.
====== Temporary Response: DONE: Where?
] Concur. Text revised with the inclusion of sediment discussions.

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827823 CRAIG ALC ENV General
-- Routing: NABL6REV<--E1ENHCLE Phone: (410) 962-6642

] Figure 1-1: This figure should be replaced with a figure that more
] accurately depicts the installation boundary. (A modified version of
] Figure 1 in the October 1997 draft Site 8 Report would be appropriate.)
]
] A/E Response (DONE: Where?)
] By: HTRW Branch Generic AE (AE)
]
] Figure has been modified as requested.
======= Temporary Response: DONE: Where?
] Figure has been modified as requested.